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Abstract

As the world grapples with the HIV pandemic, the implementation of the agenda determined by the International Conference on Population and Development (1994) at Cairo, and the matter of providing health services of adequate quality in an ethical, gender-sensitive manner, new questions are arising about how to attend to reproductive tract infections (RTIs), including sexually transmitted infections (STIs), among women. The alternatives put forward to address this need include strategies that rely on symptoms, signs, and risk factors for predicting infections without laboratory diagnosis. Such options are particularly appealing in settings where laboratory facilities are unavailable or the costs of building and sustaining them are prohibitive.

What has emerged as a particularly vexing problem is the management of chlamydia and gonorrhea infections. These STIs have serious health consequences, yet are largely asymptomatic for many women, and, among women, specific symptoms and signs do not appear to correlate consistently with infection. This situation leaves us with the difficult challenge of distinguishing between symptomatic women with vaginal infections—such as bacterial vaginosis or trichomoniasis—and those who have cervical infection with chlamydia or gonorrhea. Moreover, the large pool of asymptomatic chlamydia and gonorrhea cases makes identification of infection extremely difficult.

This paper reviews the results of validation studies of syndromic algorithms, other nonlaboratory clinically-based tools, and risk scoring for *finding* women infected with chlamydia and gonorrhea, particularly among those attending family planning and antenatal clinics in developing countries. It also examines the results of the few studies to date that have assessed syndromic algorithms and risk-scoring tools' ability to *manage* cases of chlamydia and gonorrhea among women presenting to an STI clinic with genitourinary complaints, or among symptomatic female sex workers. We analyze the risk factors explored to build such tools and review the predictive ability of the proposed and tested strategies.

Meta-analysis of nonlaboratory chlamydia/gonorrhea case-finding validation studies among general female populations and among women attending family planning and antenatal clinics found positive predictive values (PPVs) of 13 percent or less. The PPV measures the probability that a person identified as infected actually is infected. (A PPV of 13 percent indicates that 87 percent of those people identified by a diagnostic tool as infected are not infected, according to laboratory diagnosis.) These low PPVs are disappointing in terms of the prospects of finding cases of chlamydia and gonorrhea without causing concomitant large errors of overdiagnosis among women making routine visits to clinics that offer reproductive health services. We conclude, as do many of the authors of the studies cited, that these tools are not appropriate for use in finding cases of chlamydia/gonorrhea. On the other hand, studies among female sex workers, where chlamydia/gonorrhea prevalence was high (31 to 40 percent), showed a better but not excellent ability of screening tools to identify cases accurately, achieving PPVs of up to 50 percent.

Meta-analysis of the use of case-management tools among symptomatic women found PPVs ranging from 40 to 45 percent. The tools' ability to identify cases accurately among female sex workers or to manage cases among symptomatic women is better than their ability to find cases in general populations or among family planning and antenatal clinic clients as a result of the relatively higher probability of infection among sex workers and STI clinic patients.

These imperfect results leave us with several challenges. For example, at the service-delivery point, provision of appropriate counseling is complex. Misdiagnosing a woman—either telling her she is infected when she is not or that she is not infected when she is—has ramifications. Appropriate counseling messages and approaches that can relay the complexity of case-management tools' determination must be developed.

The results also raise challenges for policymakers in sorting through what course of action is most appropriate in a particular context. Research and policy analysis for determining the best approach for addressing chlamydia/gonorrhea infection in settings with different prevalence rates, program capacity, and sexual behavior patterns are lacking. Finally, simple low-cost diagnostics for use in resource-poor settings are desperately needed.

I. Introduction

Women's health advocacy and the advent of the HIV/AIDS pandemic have succeeded in focusing attention on the magnitude and consequences of reproductive tract infections (RTIs).[1] With RTIs now clearly on the agenda of the reproductive health community, the challenge is to design and implement activities that address the problem. Information to guide policy choices is abundant. For instance, RTIs are sufficiently prevalent to constitute a public health concern, yet their extent and severity are generally underestimated by professionals and the public. Moreover, these conditions are intertwined with social, gender, and behavioral issues that are manifested in access to services, women's health-seeking behavior, and power differentials in relationships that make it difficult for women to insist on condom use.

Clinically, we know how to treat specific infections in individual patients; we know that infections may interact with the contraceptive services that family planning programs have traditionally provided; and we know that sexually transmitted infections (STIs) act as significant co-factors in HIV transmission.

At the same time, we lack much information. As we grapple with how best to expand and improve programs for prevention, diagnosis, and treatment, we are confronted with challenges, difficult decisions, and less-than-optimal choices. For example, policy decisions will have to be made with an awareness of the implications of country-specific burdens of infection, taking into consideration the variability between and within countries in prevalence of different RTIs. Some interventions can be relatively straightforward, such as preventing iatrogenic infections—that is, RTIs that occur as a result of medical procedures such as abortion and IUD insertion—through better quality of care in service-delivery settings. Others are more challenging; for example, diagnosing some of the most harmful STIs, such as chlamydia and gonorrhea.

STI prevention requires attention to a number of behavioral issues, including the timeliness of seeking medical attention and sexual behavior. STIs are not like other

infections: They are highly stigmatized and reflect the unequal power dynamic of many relationships, including norms of masculine and feminine behavior that encourage multiple partners for males while limiting women's ability to assert themselves to assure safer sex.

Laboratory diagnosis and treatment is also complex and lies beyond the financial and technical capacity of the vast majority of resource-constrained health systems. Simple diagnostic tests exist for some STIs,[2] but not for others. Bacterial vaginosis, trichomoniasis, and candidiasis can be definitively diagnosed with rapid tests, but even these are not available at most peripheral sites. For *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) infections, more sophisticated laboratory tests are required.

Despite these challenges, the urgency born of recent attention to RTIs has impelled the international health community, some governments, and many nongovernmental service providers to seek to do something now to implement ideas that appear useful in addressing the problem.

Among the appealing approaches are tools or strategies that seek to manage RTIs in low-resource settings without laboratory diagnosis. Nonlaboratory management strategies, specifically syndromic algorithms and risk scoring, have been developed to assist clinicians in deciding in a systematic fashion—given presenting signs and symptoms and/or a client's social and behavioral risk factors—whether the client may have an infection, what are the likely causative agents, and what is the best presumptive treatment. These tools do not rely on certain diagnosis, rather on the probability that certain symptoms, signs, demographic characteristics, and risk behaviors are likely to be associated with infection.

Findings in a variety of contexts have shown, however, that even when women notice vaginal discharge, pain, or other symptoms, they often consider such problems a woman's burden to bear and do not seek appropriate health care. "[A] large proportion of gonococcal and chlamydial infections in women are asymptomatic, and many infected women fail to seek health care. Thus, control strategies based on active case finding are needed."

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[1] RTIs include bacterial, viral, and protozoal infections of three basic types: those that are sexually transmitted (such as chlamydia and gonorrhea); endogenous infections that result from an overgrowth of organisms normally present in the reproductive tract (such as candidiasis and bacterial vaginosis); and iatrogenic infections that result from medical procedures.

[2] For instance, *trichomonas vaginalis* can be diagnosed with a saline wet mount; candidiasis with 10 percent KOH (potassium hydroxide) prep or gram stain; and bacterial vaginosis with positive saline wet mount, amine odor when combined with 10 percent KOH, and vaginal pH greater than 4.5, or gram stain (Celum et al. 1994).

(Vuylsteke et al. 1993b:82) Even highly symptomatic women may dismiss symptoms as "normal" and fail to seek care, may be unwilling to visit an STI clinic, or may not know whom to ask for assistance. Yet these same women may routinely appear for family planning or pregnancy services. The hope has also been expressed, therefore, that simplified tools might be used not only to decide how to manage the cases of women who present to clinicians with symptoms of RTIs but also to find cases of infection among general populations of sexually active women.

The ability to identify infections with such "low-tech" tools would obviously be particularly important for those infections that are both difficult to diagnose in low-resource settings and important in terms of health consequences for women. Candida, trichomoniasis, and bacterial vaginosis are, in fact, diagnosable with simple microscopy, but the health consequences of these infections are not thought to be severe. Gonorrhea and chlamydia, in contrast, are more difficult or impossible to diagnose with the current simple technology available, and both can have serious health consequences. Their presence is a contraindication to the provision of contraceptive methods (IUDs) that form the basis of many national family planning programs, and they present health risks during other common events such as childbirth and abortion. Finding cases of chlamydia and gonorrhea is especially problematic, because a significant proportion of infected women exhibit no signs or symptoms.

The attraction of management strategies such as syndromic algorithms and risk scoring is clear for finding chlamydia and gonorrhea cases among women seeking routine health services from family planning and antenatal clinics. If tools can be developed that allow clinicians to find cases of chlamydia and gonorrhea among their clients, and to treat them appropriately, the quality of contraceptive services would improve, morbidity would decrease, and the transmission of STIs and HIV transmission would be slowed. As the results of validation trials continue to emerge, however, increasingly the predictive ability of such strategies to identify chlamydia and gonorrhea infections is found to be limited among the populations most likely to use existing reproductive health services. Of equal concern is that the ability of syndromic algorithms and risk scoring to identify chlamydia and gonorrhea infections among the populations of women likely to be infected—such as sex workers and symptomatic STI clinic clients—also appears to be limited in many settings.

This paper reviews studies that have assessed the effectiveness of nonlaboratory management strategies for finding cases of gonorrhea and chlamydia infection among family planning, antenatal care, and general populations in developing countries, populations usually having relatively low-to-moderate STI prevalence. We also look at studies in which nonlaboratory tools have been used to find cases of chlamydia and gonorrhea among a population of women for which the prevalence of STIs is relatively high (that is, female sex workers). Finally, studies that assess the ability of STI management strategies to manage cases of infections among symptomatic women (that is, STI clinic clients and symptomatic female sex workers) are also reviewed. We assess the implications of the results of the validation studies at the research, program, and policy levels.

The Structure of the Paper

Section II provides a brief overview of the importance of cervical infections and their prevalence derived from studies among diverse populations of women in developing countries. In Section III, methods for assessing the usefulness of nonlaboratory tools are discussed.[3] We outline how associations between a factor and infection are measured, and how predictive ability is ascertained, and discuss what these measurements mean to practitioners. This section also includes a discussion of how nonlaboratory tools are constructed and how they have evolved.

Section IV reviews the results of the studies. We summarize common correlations that researchers have found between chlamydia/gonorrhea infection and specific symptoms, signs, simple tests, and social, demographic, and behavioral characteristics in developing countries. These associations represent some of the factors explored for inclusion as criteria in a variety of algorithms and risk-scoring tools that were created, adapted, or refined to fit local conditions. This section also reviews validation studies of nonlaboratory tools developed to find or manage chlamydia and/or gonorrhea infection in women and concludes with a discussion of the results of these studies.

[3] The term "nonlaboratory tools" will be used throughout this paper to refer to tools such as syndromic algorithms and risk scoring, in contrast with etiologic tests that provide a definitive diagnosis such as culture.

Sections V and VI consider where the accumulated knowledge leaves the field, what are the main gaps in our understanding, and what are the principal research, programmatic, and policy implications.

II. Importance and Prevalence of Chlamydia and Gonorrhea Infections

Women generally suffer greater health consequences than do men from sexually transmitted infections. Among the most serious nonviral infections are chlamydia and gonorrhea. Among women, these can lead to upper reproductive tract infection, that is, pelvic inflammatory disease (PID) (Westrom 1980; Westrom and Mardh 1984). Without treatment, PID can lead to infertility, ectopic pregnancy, chronic pelvic pain, and recurrent infection. In most developing country settings, increased risk of ectopic pregnancy means increased risk of mortality. Among infected women, risk of pelvic inflammatory disease increases significantly in association with transcervical events such as abortion, IUD insertion, and giving birth (Ory 1978; Plummer et al. 1987; Westrom and Mardh 1989).

STIs also affect pregnancy outcome. Stillbirth has been associated with chlamydia, cytomegalovirus, and syphilis (Martin et al. 1982; Brunham et al. 1984b). Almost every RTI has been associated with premature birth, intrauterine growth retardation, or both (Barnes 1979; Hauth et al. 1995; Hillier et al. 1995). *Ophthalmia neonatorium*, which, if left untreated can lead to blindness, is caused by gonorrhea and chlamydia, and is acquired as neonates pass through the infected birth canal.

Because of their inextricable link with sexual behavior, the social consequences of STIs are considerable as well. As the implications of a diagnosed STI in one partner are confronted, they can cause mental anguish and undermine trust in the relationship. For women in abusive relationships, physical harm can result—regardless of who infected whom. In contexts where women's sexuality is strictly controlled, inference or accusation of an extramarital sexual liaison can mean the end of a woman's marriage, her social ostracism, bodily harm, and, in extreme situations, even her death.

Women also bear the larger burden of the social stigma associated with infertility, one of the possible consequences of untreated RTIs.[4] Women may suffer psychologically when they cannot meet social expectations in their role as mothers or as a result of actual or de facto divorce when they are cast out of marital relationships into economically precarious situations. In some cases, a woman must contend with her husband's taking another—or an additional—wife or partner as a result of her infertility.

Women are not only disproportionately affected by the health and social consequences of STIs but are also disproportionately vulnerable to infection because of their anatomy and physiology. A woman is two times as likely as a man is to contract chlamydia or gonorrhea during sex with an infected partner (Donovan 1993). Adolescent girls appear to have even greater vulnerability than older women because of their biologically immature cervices (Shafer and Sweet 1990), their hormonal changes, and their lower immunity to STIs (Brookman 1990). The sexually transmitted nature of certain human papilloma virus (HPV) strains has been associated with several different genital tract cancers in men and women. Cervical cancer is the most important of these. A woman's risk of cervical cancer increases not only as her number of sexual partners increases (Muñoz et al. 1996), but also as the number of her partner's sexual partners increases (Thomas et al. 1996).

Finally, women are more vulnerable to infection because of their position in society. Women and girls often have limited power to determine the nature and terms of a sexual encounter: whether to have sex at all, whether condoms are used, whether a partner is tested for STIs, or whether a relationship is monogamous. Each of these conditions will affect her health, yet she may be unable, or feel it is futile, to assert her needs. "For many women, the perceived risk of being beaten, divorced or abandoned, or of losing a source of emotional or financial support, far exceeds the perceived health risk of acquiring an STD." (Dixon-Mueller and Wasserheit 1991:10–11)

The World Health Organization (WHO) estimates that globally, 333 million new cases of curable sexually transmitted infections (syphilis, gonorrhea, chlamydia, and trichomoniasis) occur annually. This figure does not include the yearly incidence of chancroid, HIV, human papilloma virus, hepatitis B virus, and herpes simplex virus, among

[4] An estimated 50 to 80 percent of infertility in Africa, 15 to 40 percent of infertility in Asia, and about 35 percent of infertility in Latin America is caused by pelvic inflammatory disease (Wasserheit and Holmes 1992).

others, nor does it include endogenous RTIs such as candidiasis or bacterial vaginosis. Among the infections in the WHO estimate, the one thought to have the highest incidence is trichomoniasis, with 170 million new cases per year. Chlamydia is second with 89 million, then gonorrhea with 62 million, and syphilis with 12 million new cases annually (Gerbase et al. 1998).

An early comprehensive review of prevalence studies of reproductive tract infections conducted in developing countries (Wasserheit 1989) found few population-based studies available and little research on the prevalence of chlamydia and bacterial vaginosis. Although there was extreme variability in the nature and quality of the laboratory tests used in the studies reviewed, Wasserheit found RTIs to be common among women who are not acknowledged sex workers in almost all developing countries where data were available. Prevalence was higher in African populations than in those of Asia or Latin America, but there were no consistent prevalence patterns with respect to specific pathogens (see Table 1).

Table 1 Prevalence rates of chlamydia and gonorrhea infection among women in developing countries, by region

Region	Chlamydia	Gonorrhea	
	Rates published (%)	**Median** (%)	**Range** (%)
Africa	4, 6, 7, 23	10	0–40
Asia	2, 14	1	0.3–12
Latin America	No published data	6	2–18

Source: Wasserheit (1989).

Prevalence data in this review of validation studies reinforce Wasserheit's original conclusions: STIs are common; prevalence rates appear to be higher in Africa than in other developing country regions; and no consistent prevalence patterns are found for specific pathogens. More data are available on chlamydia today than when the Wasserheit review was published nine years ago.

Africa

Details of selected studies investigating the prevalence of chlamydia and/or gonorrhea among women in Africa are shown in Table 2.[5] This table is sorted by type of populations investigated, specifically: asymptomatic women; general populations of sexually active women as represented by community-based samples and women attending routine clinics such as family planning or antenatal services; symptomatic women; and women at higher risk, such as STD clinic clients and female sex workers.

Table 2 Findings from selected studies investigating prevalence of chlamydia and gonorrhea in Africa, by population type

Population type	Chlamydia (%)	Gonorrhea (%)
Asymptomatic women	6, 7 (two populations)	5, 10 (two populations)
Mixed asymptomatic and symptomatic women (community-based and all or randomly selected clients at routine clinics)	Range: 3.1–18.0; median: 8.0; mean: 8.8 (13 studies, 14 populations)	Range: 0–10.0 median: 3.1; mean: 3.7 (14 studies, 15 populations)
Symptomatic women	Range: 12.0–27.8; median: 20.4; mean: 20.1 (four studies)	5.3, 10.9, 12.3; (three studies)
STD clinic clients and female sex workers	Range: 6.4–14; median: 13.0; mean: 11.6 (four studies)	Range: 14.0–37.0; median: 21.2; mean: 23.4 (four studies)

As expected, the prevalence of chlamydia and gonorrhea is higher among symptomatic women, STD clinic clients, and sex workers. Prevalence levels among general populations of African women are highly variable, but relatively high. Among symptomatic women in these studies, the prevalence of chlamydia was about one in five women, and of gonorrhea, about half of that.

Asia and the Pacific

Table 3 shows the prevalence of chlamydia and gonorrhea according to selected studies conducted in Asia and the Pacific.

[5] One study by Pham-Kanter et al. (1996) is itself a review of numerous studies in South Africa.

Table 3 Findings from selected studies investigating the prevalence of chlamydia and gonorrhea in Asia and the Pacific, by population type

Population type	Chlamydia (%)	Gonorrhea (%)
Asymptomatic women	3.4 (one study)	0 (one study)
Mixed asymptomatic and symptomatic women (community-based and all or randomly selected clients at routine clinics)	Range: 0.5–24.9; median: 5.1; mean: 7.2 (12 studies, 14 populations)	Range: 0–1.5; median: 0.3; mean: 0.5 (nine studies)
Symptomatic women	3.7 (one study)	0 (one study)
STD clinic clients and female sex workers	37.6, 62.8 (two studies)	na

na = Not available.

Latin America and the Caribbean

Selected studies from Latin America and the Caribbean describing the prevalence of chlamydia and gonorrhea are shown in Table 4, according to population type.

Table 4 Findings from selected studies investigating the prevalence of chlamydia and gonorrhea in Latin America and the Caribbean, by population type

Population type	Chlamydia (%)	Gonorrhea (%)
Asymptomatic women	na	na
Mixed asymptomatic and symptomatic women (community-based and all or randomly selected clients at routine clinics)	Range: 2.5–26.7; median: 11.5; mean: 12.4 (five studies, eight populations)	Range: 0–2.5; median: 0.5; mean: 0.9 (three studies, six populations)
Symptomatic women	na	na
STD clinic clients and female	14.3, 24.9	16.4

sex workers	(two studies)	(one study)

na = Not available.

Conclusion

Although we cannot compare these studies directly, given their variations in diagnostic criteria and measurement techniques, they do suggest trends. For the populations studied, with the exception of sex workers and women attending STD clinics, chlamydia has a higher prevalence than does gonorrhea. The prevalence of gonorrhea appears to hover below 3 percent in Asia and in Latin America and the Caribbean, and, again, excepting the rates for STD clinic clients and female sex workers, it is generally below 10 percent in Africa. In contrast, the prevalence of chlamydia seems to vary widely across and within regions—from below 5 percent to around 25 percent in all regions.

III. Algorithms and Other Nonlaboratory, Clinically-based Tools: What Are They? How Are They Developed? How Do We Judge Their Efficacy?

To understand how management strategies such as syndromic algorithms and risk scoring work, how we can measure their usefulness, and what they can and cannot do, this section presents the theory behind these tools, their uses, and the relevant statistical measures.

Diagnosis

Treatment for disease is indicated when the best available test to detect the condition—called the standard diagnostic test—is positive. Standard diagnostic tests identify the presence of the infectious pathogen, primarily through laboratory-based processes, thereby determining as nearly as possible whether a person is infected or not. Although standard diagnostic tests are frequently referred to as the "gold" standard, this is not a

completely accurate descriptor, because even the best diagnostic tools currently available are imperfect.

In terms of reproductive tract infections, the most prevalent are those that are more easily diagnosed and those with less severe sequelae, such as trichomoniasis, candidiasis, and bacterial vaginosis. As yet, no simple, inexpensive means exist for diagnosing cervical gonorrheal and chlamydial infections. The test most commonly used for gonorrhea diagnosis is culture (86–96 percent sensitive; see Wentworth et al. 1991), which requires a culture medium, an incubator, an enriched CO_2 environment, careful handling in transport to a lab if an incubator is not available locally, and a trained technician. Chlamydia culture, also complex and reported to be 89 percent sensitive (Wentworth et al. 1991), is not used as the standard diagnosis in most studies. Other tests are more commonly used for chlamydia diagnosis and are less sensitive (direct fluorescent antibody [DFA] and enzyme immunoassay [EIA]). More recently, polymerase chain reaction (PCR) and ligase chain reaction (LCR) have emerged as the standard tests for chlamydia, with sensitivity and specificity better than those from culture (Buimer et al. 1996; Gray and Wawer 1996; Puolakkainen et al. 1998; Stary et al. 1997).

Screening

Screening mechanisms, whether they employ nondefinitive diagnostic laboratory tests, or variables identified through physical exams or questionnaires, either singly or grouped into complex algorithms, attempt to sort a subgroup of persons who *probably* have a disease from those who *probably* do not. Individuals screened as "positive" are not diagnosed with a disease by the screen, rather they are referred for definitive laboratory diagnosis and given appropriate treatment. Such selective screening seeks to minimize the number of "gold-standard" diagnostic tests performed while maximizing the identification of infections. "Universal screening" is the term for the nonselective testing of everyone in the population with the definitive diagnostic test.

Selective screening for chlamydia might involve choosing and testing a subgroup of clients that has a higher suspected prevalence of infection (for example, young women with

multiple partners) than that among all women attending a family planning clinic. This strategy avoids testing clients who are thought unlikely to be infected, thereby theoretically increasing the prevalence rate of infection among the identified subgroup and increasing the predictive value of the screening test (see discussion below on the effects of prevalence on positive predictive value).

As noted above, in the cases of chlamydia and gonorrhea, many women are asymptomatic, and because existing standard diagnostic tests are expensive and laboratory-dependent, selective screening is an enticing option. By looking at various combinations of symptoms, signs, risk factors, and the results of simple tests, researchers in developed countries have tried to identify criteria that maximize the number of infected individuals and minimize the number of uninfected individuals identified as "possibly infected" by the screening test.

In the United States, selective screening for chlamydia based on clinical signs and risk factors, followed by standard diagnostic testing of individuals with a positive screen and treatment of individuals with a positive diagnosis, has been associated with a decrease in the prevalence of chlamydia in family planning clinics in Wisconsin (Addiss et al. 1993) and in four other states (Alaska, Idaho, Oregon, and Washington) (Britton et al. 1992).

Nonlaboratory Tools for Case Management and Case Finding

The use of standard laboratory tests for chlamydia and gonorrhea is logistically and economically infeasible in many developing countries, particularly in rural settings. Therefore, several types of alternatives to laboratory diagnosis of these infections are currently being pursued by the international health-care community. These include the development of inexpensive field-based diagnostics, periodic presumptive treatment of high-risk populations, and tracing the female partners of symptomatic men. Other efforts include the development of management strategies such as syndromic algorithms and risk-scoring tools. These management strategies are based on the premise that certain variables (signs, symptoms, behaviors) indicate reliably the existence of a specific infection that can be treated effectively with available medication.

The syndromic approach to the management of reproductive tract infections classifies syndromes, that is, constellations of symptoms and signs associated with a number of pathogens and recommends drugs that treat the majority of organisms responsible for that syndrome. A clinical algorithm—a step-by-step logical flowchart—is intended for use when a patient with a syndrome presents for treatment. It guides the clinician's decisionmaking in identifying the probable infection and recommending appropriate treatment.

Such an approach has the advantage of not requiring laboratory facilities. In addition, patients are treated immediately, so they do not have to return for diagnosis, thereby reducing potential loss to follow-up and complications or further transmission during the interim between initial presentation and definitive diagnosis. Other advantages relate to standardized diagnosis, treatment, referral, data collection, and supervision of health-care workers (Vuylsteke and Meheus 1996).

In clinical use, flowcharts for genital ulcers among men and women have been shown to perform adequately as tools to manage cases of syphilis and chancroid infection (Vuylsteke and Meheus 1996; Ryan and Holmes 1995; Adler 1996). Unfortunately, vaginal discharge is more complicated. It is difficult to use algorithms to distinguish between vaginal infections (often caused by endogenous RTIs such as bacterial vaginosis and candidiasis) and cervical infections (primarily sexually transmitted and caused by chlamydia and/or gonorrhea). These two types of infection require different counseling, follow-up, and medications. In an effort to address this problem, interview questions designed for predicting risk—that is, questions based on demographic and behavioral variables thought to be associated with chlamydia and gonorrhea—have been used as a way of attempting to distinguish symptomatic women with and without cervical infection.

At the same time, researchers have documented substantial levels of RTIs among women who are not among high-risk populations. Furthermore, women's health advocates are successfully calling attention to the fact that although the understanding had always been that family planning methods should not be provided without knowledge of a woman's RTI/STI status, in practice this precaution is rarely taken.

Whereas case-management guidelines direct treatment for clients who come to a clinic with complaints, case finding actively seeks to identify cases of infection among clinic clients and general populations regardless of their symptom status. In the majority of

developing country settings where standard diagnostic tests are unavailable, case management through syndromic algorithms and risk scoring is intended as a substitute for definitive laboratory diagnosis of symptomatic women. Case finding in these settings is similar to screening in that it involves searching for cases of infection among asymptomatic women, as well as among women with symptoms who are not seeking care for RTIs, or women with unrecognized symptoms and/or signs. Such case finding in low-resource settings differs from typical screening in that referral for definitive laboratory diagnosis would rarely be possible. Instead, the screening results are used to guide presumptive treatment.

Measures to Determine the Usefulness of Screening Tests and Case-management/finding Tools

Specific criteria exist to evaluate the usefulness of screening tools. These criteria, which can also be used to assess other case-management/finding tools, are simplicity, acceptability, cost, accuracy, consistency, and efficiency (Galen 1979; Mausner and Kramer 1985). Simplicity implies that the tool is easy to administer. Acceptability and affordability of the tool are associated with higher likelihood of use. The test must provide a true measure of the conditions that it is supposed to identify (accuracy) and produce the same results when it is repeated (consistency). Most important, the test must be efficient—that is, it must identify correctly most cases of infection (sensitivity), and most individuals without infection (specificity),[6] without falsely identifying many individuals as having the condition when they do not (false-positive rate).

Positive predictive value (PPV), that is, 100 percent minus the false-positive rate, denotes the proportion of people who are identified as having the disease (as determined by the screening test or management tool) who, in fact, are infected (as determined by the standard laboratory diagnostic tests). Similarly, the negative predictive value (NPV) is the probability that a person identified by means of a tool (algorithm, risk score, or other

[6] An ideal test or algorithm would have 100 percent sensitivity and 100 percent specificity. In practice, neither measure reaches 100 percent, and a decision to choose a cutoff point with higher sensitivity is accompanied by lower specificity and vice versa. Sensitivity plus specificity must be greater than 100 percent (that is, test efficiency greater than 50 percent) if a test is to give better results than would be obtained by chance (Galen 1979).

method) as negative does not, in fact, have the disease, according to laboratory diagnosis. The FP and PPV rates are affected by the prevalence of the disease in the population and the algorithm's sensitivity and specificity.

The efficiency of a test indicates the proportion of infected *and* noninfected people who are correctly identified—that is, it reflects both sensitivity and specificity (and, therefore, FP/PPV). Efficiency thus measures the ability of a test to correctly label infected people as positive and noninfected people as negative; it is the sum of true positives and true negatives divided by the total number of people in the sample. Efficiency is also affected by the prevalence of disease in the population, but in the opposite direction of the way PPV is affected. With a low-prevalence condition, even a poor test can have high efficiency so long as it classifies the great majority of people as uninfected.

The measures commonly used to discuss the performance of algorithms, risk scores, and screening tests are shown in Table 5. As described in this table, nonlaboratory case-management/finding tools use the presence of signs, symptoms, and risk factors to guide presumptive treatment. To construct such tools, variables must be found that are strongly predictive of a disease by determining whether an association exists between a variable—for example, a symptom (what a client reports), sign (clinician's observation), test, exposure, or behavior—and the disease. The hope is to find indicators that allow us to make relevant clinical predictions.

Table 5 Measures used to discuss performance of algorithms and risk scores

Tool performance	Person actually has condition	Person does not actually have condition	Total
Identifies person as having the condition	True Positives (TP)	False Positives (FP)	TP+FP
Identifies person as not having the condition	False Negatives (FN)	True Negatives (TN)	TN+FN
Total	TP+FN	TN+FP	n

Prevalence = (TP+FN)÷n.
Odds ratio = (TPxTN)÷(FP x FN).
Sensitivity = TP÷(TP+FN).
Specificity = TN÷(TN+FP).
False-positive rate = FP÷(TP+FP).
Positive predictive value = TP÷(TP+FP), or 100 - FP rate.
Negative predictive value = TN÷(TN+FN).
Test efficiency = (TP+TN)÷n.
n = sample.

The odds ratio (OR) describes the odds of a person's having a disease with the factor present compared to the odds of having a disease with the factor absent (Mausner and Kramer 1985). The odds ratio indicates the strength of the association between a factor and a disease, whereas statistical significance indicates the probability of the association. An OR of 2.9, for instance, indicates that people exhibiting the designated characteristic have a risk of disease almost three times greater than do those who do not exhibit this factor. An OR of 1.75 indicates that the risk of disease is 1.75 times (or 75 percent) higher among those exposed to a given variable than among those who were not exposed.

The OR and its significance indicate the strength of an association and the likelihood that the association is not due to chance, and, therefore, suggest which variables might be included in screening or case-management/finding tools. Yet, strong statistical associations (generally odds ratios, and sometimes regression coefficients) found between certain signs, symptoms, or behavioral characteristics and disease status do not provide all the necessary information.

Analyses from one of the papers reviewed here illustrate this point: Vuylsteke et al. (1993b) conducted a study in an antenatal clinic in Zaire where the prevalence of chlamydia and gonorrhea was moderate (6.5 percent) (see Table 6). Women having a positive cervical swab result (10 or more polymorphonuclear leukocytes [PMNs] per high-powered field) had a 2.2 times greater risk (that is, OR = 2.2) of chlamydia/gonorrhea infection than did women with a negative swab. This finding was highly statistically significant ($p<0.001$), because most women did not have chlamydia or gonorrhea, and most women without infection in this

Table 6 Association of cervical swab results with chlamydial or gonorrheal infection among 1,160 women tested, Zaire

Cervical swab results	Has chlamydia or gonorrhea	Does not have chlamydia or gonorrhea	Total
>10 PMNS on cervical swab	True Positives 31	False Positives 261	TP+FP 292
≤10 PMNS on cervical swab	False Negatives 44	True Negatives 824	TN+FN 868
Total	TP+FN = 75	FP+TN = 1,085	n = 1,160

PMNS = polymorphonuclear leukocytes.
Prevalence = (75)÷1,160 = 6.5 percent.
Odds ratio = (31x 824)÷(261x44) = 2.22; $p<0.001$, highly statistically significant.
Sensitivity = 31÷(75) = 41.3 percent.
Specificity = 824÷(1,085) = 75.9 percent.
False-positive rate = 261÷(292) = 89.4 percent.
Positive predictive value = 31÷(292) = 10.6 percent.
Negative predictive value = 824÷(868) = 94.9 percent.
Test efficiency = (31+824)÷1,160 = 73.7 percent.
Source: Vuylsteke et al. (1993b).

large sample were correctly identified (824 of 1,085; specificity = 76 percent). Still, fewer than half of those having chlamydia/gonorrhea would have been correctly identified (31 of 75) if the swab test for PMNs were used as a screening test, and 44 of the 75 women requiring treatment would not have received it were this screening criterion used. Also, in comparison with the 31 women correctly identified as being infected, more than eight times as many women (261) who were not infected would have been falsely identified as having chlamydia/gonorrhea and would have received inappropriate treatment. The researchers thus concluded that this variable was not sensitive and specific enough to use as a proxy for the definitive detection of infection.

Such results using single factors are not uncommon. Therefore, several of the most indicative variables are frequently combined to build screening or case-management/finding tools. Tools that include multiple variables should also be evaluated based on sensitivity, specificity, PPV, false-positive rate, NPV, and test efficiency.

In the same study, the authors found similar results despite using multiple variables in a scoring system (see Table 7). The association (odds ratio) between women's having a positive score and having chlamydia/gonorrhea infection was highly statistically significant (OR = 7.12, $p<0.001$), because most women did not have chlamydia or gonorrhea, and most women without infection were correctly identified (797 of 1,085, specificity = 73.5 percent). More than half of those having chlamydia/gonorrhea would have been correctly identified (54 of 75) were the score used as a screening test; yet, 21 of the 75 women requiring treatment would not have received it were this screening criterion used. Also, in comparison with the 54 women who were correctly identified as being infected, more than five times as

Table 7 Association of positive and negative scores from multiple variables with chlamydial or gonorrheal infection among 1,160 women, Zaire

Muliple-variable score results	Has chlamydia or gonorrhea	Does not have chlamydia or gonorrhea	Total
Positive score	True Positives	False Positives	TP+FP
	54	288	342
Negative score	False Negatives	True Negatives	TN+FN
	21	797	828
Total	TP+FN = 75	FP+TN = 1,085	n = 1,160

Prevalence = (75)÷1,160 = 6.5 percent.
Odds ratio = (54x797) ÷ (288x21) = 7.12; $p<0.001$, highly statistically significant.
Sensitivity = 54÷(75) = 72.0 percent.
Specificity = 797÷(1,085) = 73.5 percent.
False-positive rate = 288÷(1,342) = 84.2 percent.
Positive predictive value = 54÷(342) = 15.8 percent.
Negative predictive value = 797÷(828) = 96.3 percent.
Test efficiency = (54 + 797)÷1,160 = 73.4 percent.
Source: Vuylsteke et al. (1993b).

many women (288) who were not infected would have been falsely identified as having chlamydia/gonorrhea and would have received inappropriate treatment.

Whereas all these measures are informative, the most important criteria for evaluating the usefulness of a screening tool or case management/finding tool are: (1) the proportion of women with the disease who were correctly identified (that is, the sensitivity of the tool), to ensure that most women requiring treatment will get it; and (2) the number and proportion of women identified as having the condition when they do not (that is, false positives and false-positive rates), to minimize the number of women who receive inappropriate care.

Although both criteria are used to evaluate screening tools in general, case-*management* strategies, which are applied only to symptomatic patients, clearly cannot determine the proportion of asymptomatic women missed (see Table 5). Management strategies are applied only to symptomatic patients and therefore can be evaluated only on the basis of the proportion of symptomatic women correctly or inappropriately treated (that is, the number and rate of false positives, or conversely, the positive predictive value).[7] Non-laboratory tools used to find cases—that is, tools applied to symptomatic and asymptomatic patients—should be evaluated by both sensitivity and false-positive/PPV criteria.

IV. Results

Methods

In two sections below, we review studies of (1) correlations of symptoms, signs, and risk factors with diagnosed infection and (2) validation trials of nonlaboratory tools for managing and/or finding chlamydia and gonorrhea in developing countries. Peer-reviewed, published, validation studies of chlamydia/gonorrhea-management strategies were identified through computer databases, specifically *PopLine* and *MedLine* from 1990 through 1997.[8]

[7] Sensitivity and specificity of the test cannot be estimated because asymptomatic women are not tested diagnostically, so we do not know how many of them are categorized accurately (true negatives) and inaccurately (false negatives).

[8] As this paper was being finished, a special supplement to the journal *Sexually Transmitted Infections* (Vol. 74, Supplement 1, 1998) was published that contains several studies on chlamydia and gonorrhea case management and finding. It is an excellent compilation that readers of this paper will find of interest. Results of the studies published in the supplement are similar to those reviewed here.

Unpublished literature and presentations at conferences during those years were also compiled.

Fifteen studies were included on the basis of their methodological soundness and their use of standard diagnostic tests to identify infection. Chlamydia was diagnosed in these studies with culture (Braddick et al. 1990); enzyme immunoassay (Kapiga et al. 1996; Vuylsteke et al. 1993b; Kaufman et al. 1996; Behets et al. 1995; Thomas et al. 1994; and Bourgeois et al. 1996); antigen detection enzyme immunoassay and confirmatory blocking antibody assay (Mayaud et al. 1995; Thongkrajai 1996; Meda et al. 1997); enzyme immunoassay confirmed by direct fluorescent assay (Ronsmans et al. 1996); enzyme immunoassay and ligase chain reaction (Coetzee and Mathews 1998); enzyme immunoassay and various polymerase chain reaction assays (Germain et al. 1997); and direct immunofluorescent assay (Acosta-Cazares et al. 1996). Gonorrhea was diagnosed in most of these studies with culture, except in one (Germain et al. 1997), which used culture or PCR assays.

Most studies tested the ability of algorithms, risk scoring, and other tools to find cases of chlamydia and/or gonorrhea among routine clinic and general populations of women. Two were conducted among community-based populations (Ronsmans et al. 1996; Kaufman et al. 1996), six among antenatal clinic clients (Braddick et al. 1990; Mayaud et al. 1995; Vuylsteke et al. 1993b; Bourgeois et al. 1996; Meda et al. 1997; and Thomas et al. 1994), two among family planning clinic clients (Costello Daly et al. 1994; Kapiga et al. 1996), one among combined family planning and antenatal clinic clients (Thongkrajai 1996), and one among patients in a rural hospital (Acosta-Cazares et al. 1996). Some of these studies tested tools recommended by WHO, or national guidelines; others sought to find variables that might be used to construct algorithms or other clinically-based nonlaboratory tools appropriate for the local setting and disease patterns; and still others did both. In all of these studies, both symptomatic and asymptomatic women were included—by selecting a community sample, by selecting women who attended a clinic within a certain time period, or by selecting women randomly from among all clinic clients. Two studies analyzed different tools' abilities to find cases of chlamydia/gonorrhea among populations engaging in high-risk behaviors, that is, female sex workers (Germain et al. 1997; and Vuylsteke et al. 1993b).

Three studies applied different algorithms as case-management tools (Behets et al. 1995; Coetzee and Mathews 1998; Germain et al. 1997). One of these (Behets et al. 1995) applied the algorithms in a field setting among STD clinic clients: Women with any urogenital complaint who presented to the STD clinic were evaluated and treated using algorithms. Another (Coetzee and Mathews 1998) simulated application of alternative-age cutoff points for the standard syndrome-based algorithm used in the province among symptomatic women attending an STD clinic. The final study (Germain et al. 1997) simulated application of a screening algorithm among a symptomatic subpopulation of the same female sex workers in Bénin.

Eight of the 12 studies among women attending routine clinics or general populations examine the ability of a management strategy to find either chlamydia or gonorrhea infection. Of the other four, three (Ronsmans et al. 1996; Acosta-Cazares et al. 1996; and Thongkrajai 1996) look only at chlamydia, and the other (Costello Daly et al. 1994) studies only gonorrhea. Combined chlamydia/gonorrhea prevalence rates in these routine-clinic study populations were all lower than 16 percent. The studies of sex workers found combined chlamydia/gonorrhea prevalences of 31 percent (Vuylsteke et al. 1993b) and 40 percent (Germain et al. 1997). The studies that tested various tools' abilities to manage cases among symptomatic women found a chlamydia/gonorrhea prevalence of 34 percent (Behets et al. 1995), 27 percent (Coetzee and Mathews 1998), and 47 percent (Germain et al. 1997).

Finally, to supplement these data, we collected articles and abstracts, published predominantly from 1990 onward, that looked at chlamydia/gonorrhea correlates. Of these, two provided sufficient data to include them in the analysis of correlations between risk factors and chlamydia/gonorrhea infection. They did not evaluate case-management/finding tools, however, and thus are referred to only in the correlations discussion below. One study was conducted among routine clinic clients and included a small proportion (fewer than 10 percent) of sex workers[9] (Herrmann et al. 1996). Polymerase chain reaction and direct fluorescent antibody tests were used to diagnose chlamydia infection; gonorrhea infection was not examined. The other study was conducted among a general population of rural

women, and used PCR and culture to diagnose chlamydia and gonorrhea respectively (Thongkrajai and Pengsaa 1997).

For both the correlations section and the section reviewing assessments of nonlaboratory tools for case finding and case management, we examine the sensitivity, specificity, positive predictive value, false-positive rate, and test efficiency. These measures are presented by selected individual variables and tools for each study included in the review.

[9] The study looked at routine clinic attenders (gynecological, family planning, and prenatal clinics) and sex workers, but the latter comprised less than 10 percent of the entire sample (926), so we have included the results in the discussion of general/routine clinic populations. The variables within this study were symptoms of vaginal discharge, abdominal pain, and itching; and signs of vaginal discharge, mucopus on cervix, edema of cervix, friability, and ectropion. Social, demographic, and behavioral variables were analyzed with regard to only the 863 women attending the routine clinics.

We also conducted meta-analyses for each of these variables and types of tools.[10] The meta-analysis was conducted by pooling the samples (individuals) from all the studies within each specified category. For instance, results of all algorithms of a defined type, such as risk scoring, that were used for case finding in routine clinic and general populations were combined. If a study tested more than one algorithm or risk-scoring tool, or tested a variable or tool separately for chlamydia and gonorrhea, only the one with the best test efficiency was used so as to include each study only once and to give the greatest chance of producing the highest screening usefulness.

Because of the way this meta-analysis was conducted, studies with larger sample sizes automatically have a greater weight than do those with smaller numbers of participants. Studies were not reweighted in any other manner (for example, by the methodological strength or weakness of a study), because diagnostic tests and methods used in the studies appeared sound. The meta-analysis process generated sample sizes from about 300 to 9,900.

Correlations of Symptoms, Signs, and Risk Factors with Infection

This section reviews the factors that were found to be useful predictors and poor predictors of chlamydia and gonorrhea infection. The analyses presented focus on bivariate associations—that is, relationships between one variable and the disease. Bivariate associations are immediately useful in developing clinical guidelines: Underlying associations are not at issue, and, if they work, the observer can predict reliably one condition (infection) from one observation (the associated variable). In contrast, multivariate analyses consider multiple factors to determine whether an independent association exists between a variable and a disease. Although multivariate analyses are important for identifing the "real" relationships between variables and disease, they are less useful to the clinician, who is mostly interested in predictors of disease, not in whether an actual cause-and-effect relationship exists. For instance, in a specific population, a strong bivariate association between pill use and chlamydia/gonorrhea may exist that, when age is considered, disappears

[10] Meta-analysis is helpful for obtaining a general summary impression. Looking at the results from the individual studies is important as well, however, for meta-analysis can obscure a range of varying conclusions and can be skewed by the results of one particularly large study; regional variation is also lost.

upon multivariate analysis. The fact still stands, however, that women in this population who use oral contraceptives are more likely to be (have greater odds of being) infected with chlamydia/gonorrhea, regardless of the "real" reason. Therefore, the use of oral contraceptives could be a valuable indicator in this population, independent of or in conjunction with other variables.

The studies investigated symptoms, signs, simple tests, and demographic and behavioral characteristics for their association with infection. Looking at the results of these analyses helps to illuminate why chlamydia and gonorrhea are such difficult infections to detect.

Appendix Tables A1 through A16 present a detailed analysis of common variables investigated for their relation to chlamydia and gonorrhea infection. For each variable, we also conducted a meta-analysis according to the prevalence of the condition, which is affected by the type of study and study population. We examined:

(1) studies among general and routine clinic populations with moderate prevalence of chlamydia and gonorrhea, including both symptomatic and asymptomatic women, designed to explore the usefulness of case-finding tools or to determine the variables associated with infection;
(2) studies including both symptomatic and asymptomatic women that tested the ability of tools to find cases among female sex workers having a relatively high prevalence of chlamydia/gonorrhea infection; and
(3) validation studies of case-management tools used among symptomatic women.

Data from the studies among symptomatic and asymptomatic women attending routine clinics or in general populations, are presented in Appendix Tables A1 through A16 and in Table 8 below in summary meta-analyses. Both the individual studies and the meta-analyses show that in these groups, variables generally do not correlate consistently with infection, demonstrating poor sensitivity and high false-positive rates.

Among symptoms examined in meta-analysis, for instance, only 28 percent of women with chlamydia/gonorrhea infection noted the symptom of vaginal discharge. Appendix Table A1 shows sensitivities ranging from 4 to 77 percent, with the majority of studies

finding that self-reported vaginal discharge identified 30 percent or fewer of those needing treatment. The meta-analysis data also show that 92 percent of those with the symptom of vaginal discharge (with a range of 84 to 96 percent) did not have chlamydia/gonorrhea and, therefore, did not require treatment for these infections.

In these same populations, the only clinician-identified sign that, in meta-analysis, was found among more than 50 percent of women with chlamydia/gonorrhea infection was vaginal discharge. Appendix Table A4 shows that the sign of vaginal discharge was present in 3 to 89 percent of those women infected. At the same time, between 79 and 99.6 percent of women who had the sign of vaginal discharge did not have chlamydia or gonorrhea. Thus, if clinicians had used the sign of vaginal discharge to determine whether treatment for chlamydia/gonorrhea were necessary, they would have incorrectly identified ten times as many women for inappropriate than for appropriate treatment.

Simple tests—such as leukocyte esterase dipstick or microscopic analysis of polymorphonuclear leukocytes—also did not show good predictive ability (see Table 8 and Appendix Tables A8 and A9) in this population.

Among demographic and behavioral variables examined (Appendix Tables A10 through A16), only young age and not using condoms were associated with 50 percent or more of infections in meta-analyses. The PPV (meta-analysis) of these variables, however, was low: 6 percent for young age, and 4 percent for not using condoms. Thus, between 79 and 99 percent of women of young age, and between 81 and 97 percent of women who did not use condoms did not have chlamydia/gonorrhea.

Table 8 Meta-analysis of symptoms, signs, and risk factors among mixed symptomatic and asymptomatic women in general and routine clinic populations

Specification	Prevalence	Sensitivity	Specificity	Positive predictive value	False-positive rate	Test efficiency	(n)
Symptom: vaginal discharge	**6.8**	110/398 **27.6**	4,100/5,445 **75.3**	110/1,455 **7.6**	1,345/1,455 **92.4**	4,210/5,843 **72.1**	(5,843)
Symptom: vaginal itch	**5.7**	70/263 **26.6**	3,225/4,318 **74.7**	70/1,163 **6.0**	1,093/1,163 **94.0**	3,295/4,581 **71.9**	(4,581)
Symptom: abdominal/ lower abdominal pain	**6.7**	140/398 **35.2**	3,833/5,517 **69.5**	144/1,808 **8.0**	1,664/1,808 **92.0**	3,993/5,915 **67.5**	(5,915)
Sign: vaginal discharge	**6.8**	244/411 **59.4**	2,680/5,624 **47.7**	244/3,188 **7.7**	2,944/3,188 **92.3**	2,924/6,045 **48.4**	(6,045)
Sign: mucopus	**6.7**	69/255 **27.1**	3,269/3,550 **92.1**	69/351 **19.7**	282/351 **80.3**	3,338/3,805 **87.7**	(3,805)
Sign: cervical friability	**6.9**	105/325 **32.3**	3,397/4,384 **77.5**	105/1,102 **9.5**	997/1,102 **90.5**	3,507/4,719 **74.3**	(4,719)
Sign: cervical ectopy	**6.1**	23/186 **12.4**	2,726/2,886 **94.5**	23/183 **12.6**	160/183 **87.4**	2,769/3,072 **90.1**	(3,072)
Test: LED	**5.2**	17/101 **16.8**	1,491/1,850 **80.6**	15/374 **4.0**	359/374 **96.0**	1,508/1,951 **77.3**	(1,951)
Test: PMNS	**6.6**	113/306 **36.9**	3,453/4,349 **79.4**	113/1,009 **11.2**	896/1,009 **88.8**	3,566/4,655 **76.6**	(4,655)
Risk: young age	**4.9**	235/454 **51.8**	5,344/8,881 **60.2**	235/3,772 **6.2**	3,537/3772 **93.8**	5,579/9,335 **59.8**	(9,335)
Risk: Unmarried	**5.5**	162/451 **35.9**	5,538/7,784 **71.1**	162/1,737 **9.3**	1,575/1,737 **90.7**	6,371/8,235 **77.4**	(8,235)
Risk: >1 partner in specified time period	**5.8**	110/513 **21.4**	7,566/8,278 **91.4**	107/813 **13.2**	705/813 **86.7**	7,673/8,791 **87.3**	(8,791)
Risk: partner symptomatic	**5.9**	8/155 **5.2**	2,336/2,475 **94.4**	8/147 **5.4**	139/147 **94.6**	2,344/2,630 **89.1**	(2,630)
Risk: condom not used	**4.7**	236/297 **79.5**	629/6,073 **10.4**	236/5,680 **4.2**	5,444/5,680 **95.8**	865/6,371 **13.6**	(6,371)
Risk: oral contraceptives	**4.0**	66/244 **27.1**	4,584/4,883 **93.9**	66/1,388 **4.7**	1,322/1,388 **95.3**	4,650/6,150 **75.6**	(6,150)
Risk: IUD use	**4.4**	55/341 **16.1**	5,972/7,453 **80.1**	55/1,543 **3.6**	1,488/1,543 **96.4**	6,027/7,794 **77.3**	(7,794)

LED = Leukocyte esterase dipstick. PMNS = Polymorphonuclear leukocytes.

Data from research among populations including both symptomatic and asymptomatic female sex workers demonstrate that the predictive ability of specific variables for chlamydia/gonorrhea infection improves when the prevalence of infection increases.

The false-positive rate generally declines (and the PPV generally improves) in groups showing higher prevalence, because more people actually have the infection. Nevertheless, sensitivity and the false-positive rate are equally important when the condition is more common (between 25 percent and 75 percent), as is overall test efficiency. Data from the Vuylsteke et al.(1993b) study of female sex workers in Zaire among whom the prevalence of chlamydia and gonorrhea was high (31 percent) illustrate this point. The PPV of cervical ectopy is higher among the female sex workers (42 percent) than among pregnant women (11 percent). However, only 12 percent of the female sex workers with chlamydia/gonorrhea had cervical ectopy (see Table 9). Indeed, there were more uninfected women (60) who had cervical ectopy than there were women who had chlamydia/gonorrhea and cervical ectopy (44).

Table 9 Association of cervical ectopy with chlamydial or gonorrheal infection among female sex workers, Zaire

Status	Has chlamydia or gonorrhea	Does not have chlamydia or gonorrhea	Total
Has cervical ectopy	True Positives 44	False Positives 60	TP+FP 104
Does not have cervical ectopy	False Negatives 335	True Negatives 783	TN+FN 1,118
Total	TP+FN = 379	FP+TN = 843	n = 1,222

Prevalence = (379)÷1,222 = 31.0 percent.
Odds ratio = (44x783)÷(60x335) = 1.71; $p < 0.01$.
Sensitivity = 44÷(379) = 11.6 percent.
Specificity = 783÷(843) = 92.9 percent.
False-positive rate = 60÷(104) = 57.7 percent.
Positive predictive value = 44÷(104) = 42.3 percent.
Test efficiency = (44+783)÷1,222 = 67.7 percent.
Source: Vuylsteke et al. (1993b).

Data from the two studies among symptomatic and asymptomatic populations of female sex workers (chlamydia/gonorrhea prevalence of 31 and 40 percent) are shown in Appendix Tables A1 through A16 and in the summary meta-analysis below in Table 10. Of the symptoms and signs examined, only one variable had sensitivity greater than 50 percent: For the sign of vaginal discharge, Vuylsteke et al. (1993b) found 63 percent sensitivity and

Germain et al. (1997) found 58 percent sensitivity (Appendix Table A4). The PPV for the sign of vaginal discharge among these women was 36 and 55 percent—that is, of the women with the sign of vaginal discharge, 64 and 45 percent (Vuylsteke and Germain, respectively) did *not* have chlamydia/gonorrhea infection.

Table 10 Meta-analysis of symptoms, signs, and risk factors among mixed symptomatic and asymptomatic women in populations engaged in "high-risk" behavior

Specification	Prevalence	Sensitivity	Specificity	Positive predictive value	False-positive rate	Test efficiency	(n)
Symptom: vaginal discharge	**35.0**	162/556 **29.1**	796/1,032 **77.1**	162/398 **40.7**	236/398 **59.3**	958/1,588 **60.3**	(1,588)
Symptom: abdominal/ lower abdominal pain[a]	**31.0**	168/379 **44.3**	513/843 **60.9**	168/498 **33.7**	330/498 **66.3**	681/1,222 **55.7**	(1,222)
Sign: vaginal discharge	**35.0**	342/556 **61.5**	529/1,032 **51.3**	342/845 **40.5**	503/845 **59.5**	853/1,588 **53.7**	(1,588)
Sign: mucopus[a]	**31.0**	51/379 **13.5**	824/843 **97.7**	51/70 **72.9**	19/70 **27.1**	875/1,222 **71.6**	(1,222)
Sign: cervical friability[a]	**31.0**	27/379 **7.1**	827/843 **98.1**	27/43 **62.8**	16/43 **37.2**	854/1,222 **69.9**	(1,222)
Sign: cervical ectopy[a]	**31.0**	44/379 **11.6**	783/843 **92.9**	44/104 **42.3**	60/104 **57.7**	827/1,222 **67.7**	(1,222)
Risk: young age[a]	**31.0**	243/379 **64.1**	488/843 **57.9**	243/597 **40.7**	354/597 **59.3**	731/1,222 **59.8**	(1,222)
Risk: >1 partner in specified time period[a]	**31.0**	300/379 **79.2**	221/843 **26.2**	300/922 **32.5**	622/922 **67.5**	521/1,222 **42.6**	(1,222)
Risk: no condom[a]	**31.0**	334/379 **88.1**	100/843 **11.9**	334/1,077 **31.0**	743/1,077 **69.0**	434/1,222 **35.6**	(1,222)

[a] Because multiple studies are lacking, this specification represents single-study results rather than meta-analysis.

Demographic and behavioral risk characteristics (Appendix Tables A10 through A16) had better sensitivity (ranging from 64 to 88 percent), but generally low specificity (12 to 58 percent). This situation leads to high false-positive rates (59 to 69 percent) in groups for which 50 percent or more of the women are not infected.

Overall, the symptoms, signs, and risk factors investigated have higher PPVs among female sex workers than among routine clinic attendees and general populations, ranging from 31 to 73 percent. Sensitivity of these variables among female sex workers also appears to be slightly higher, with the exception of cervical signs (mucopus, cervical friability, and cervical ectopy).

Data from the validation studies of syndromic case-management tools give an indication of the degree to which different variables correlate with chlamydia and gonorrhea infection among symptomatic women. An additional caveat is that symptomatic women in some of these studies were seeking services at an STD clinic and may have already suspected that they might be infected. The variables for which data were available to calculate measures of correlation are shown in Table 11 (see also Appendix Tables A5, A10, and A11).

Table 11 Meta-analysis of signs and risk factors among symptomatic women seeking services at STD clinics

Specification	Prevalence	Sensitivity	Specificity	Positive predictive value	False-positive rate	Test efficiency	(n)
Sign: mucopus[a]	**31.9**	59/81 **72.8**	96/173 **55.5**	59/136 **43.4**	77/136 **56.6**	155/254 **61.0**	(254)
Risk: young age	**32.5**	109/288 **37.9**	461/597 **77.2**	109/245 **44.5**	136/245 **55.5**	570/885 **64.4**	(885)
Risk: unmarried[a]	**33.7**	164/244 **67.2**	195/480 **40.6**	285/449 **63.5**	164/449 **36.5**	359/724 **49.6**	(724)

[a] Because multiple studies are lacking, this specification represents single-study results rather than meta-analysis.

Even in this population, where prevalence is high and the women are seeking care for a suspected STI, the variables investigated perform only poorly to moderately well (PPV from 34 to 64 percent).

Results of Assessments of Nonlaboratory Tools Used for Case Finding and Case Management of Chlamydia and Gonorrhea

The associations found in bi- or multivariate analyses have been used to construct and adapt algorithms and risk-assessment tools. No single variable consistently predicts chlamydia and gonorrhea infection, as is demonstrated in the data above, but *combinations* of variables identified via laboratory tests, physical exams, or questionnaires have been thought potentially to perform better. As noted above, the advantage of such an approach is that it does not require laboratory diagnosis or facilities and eliminates the need to delay treatment. If such a system proves to have high sensitivity, low false-positive rates, and high test efficiency, a syndromic approach could help standardize diagnosis, treatment, and referral;

simplify RTI data collection, analysis, and reporting from different health facilities; and facilitate supervision (Vuylsteke and Meheus 1996).

In this section, we review studies that have assessed the performance of various nonlaboratory tools, categorized here as follows:

(1) Types of tools evaluated:

- *Simple tools* Tools based only on symptoms and/or signs in settings where a speculum exam is not possible. These include, individually or in combination, symptoms and signs such as dysuria or vaginal discharge.
- *Simple tools using a speculum exam* Tools that include a speculum exam or those based solely on signs determined during a speculum exam, such as endocervical mucopus or cervical friability. Some also include simple microscopy tests.
- *Tools with risk factors* Tools that include background or behavioral factors such as marital status, age, having more than one sex partner, or those including risk factors in combination with symptoms, signs, and/or simple tests.
- *Risk scoring* Risk scoring assigns values to the presence of particular variables (symptoms, signs, and/or risk factors). If the total reaches a certain cutoff point, the woman is treated for infection. This approach differs from the other tools in that it considers multiple variables simultaneously and weights some variables as more important than others by assigning them a higher value. This is the most complex way to integrate information in a management tool.

(2) Uses to which tools are put, categorized, where appropriate, by the types of populations in which the tools are evaluated:

- *Case finding among*:
  - mixed populations of symptomatic and asymptomatic women among general and routine clinic populations
  - mixed populations of symptomatic and asymptomatic women among populations engaged in high-risk behavior, that is, female sex workers

- *Case management* among symptomatic women attending an STI clinic or among symptomatic female sex workers

Simple Tools Without Speculum Exams

Case finding: routine clinic and general populations (moderate prevalence)

Five simple tools were tested in four of the studies among routine clinic/general populations (see Appendix Table A17). Predictive value, in meta-analysis, was 11 percent (ranging from 9 to 16 percent). In this same analysis, the tools were able to identify 38 percent of women with chlamydia/gonorrhea (sensitivities ranged from 24 to 72 percent, with only one of the five tools having a sensitivity greater than 60 percent). The algorithm with the highest sensitivity used any symptom related to the genital tract and successfully identified 72 percent of individuals with chlamydia/gonorrhea, but would unnecessarily treat 91 percent of those identified with the algorithm (PPV equals 9 percent), resulting in an overall test efficiency of 38 percent (Mayaud et al. 1995).

Case finding: female sex worker populations (high prevalence)

In addition to antenatal clinic clients, the study in Zaire (Vuylsteke et al. 1993b) also looked at a population of female sex workers (see Appendix Table A17). For this population, the simple algorithm for vaginal discharge and abdominal pain gave a PPV of 34 percent, and sensitivity and specificity of 55 and 52 percent, respectively. The tool was, therefore, better able to find cases among sex workers than among antenatal clinic clients (PPV among antenatal clinic clients was 12 percent and sensitivity was 48 percent). However, two-thirds of female sex workers identified as infected by the algorithm would, in fact, not be, and overall test efficiency was still low at 53 percent.

Tools Using Speculum Exams

Case finding: routine clinic and general populations (moderate prevalence)

Seven of the studies looked at ten tools for case finding among women in this population (see Appendix Table A18). The test efficiency of the tools, in meta-analysis, was 83 percent, but the ability of the tools to identify infected women is poor. Sensitivity of the tools was 25 percent, with most tools identifying fewer than 50 percent of chlamydia/ gonorrhea cases (range: 3 to 100 percent). The PPV in the meta-analysis was 9 percent—that is, the proportion of women incorrectly identified by the tools as having chlamydia/gonorrhea was 91 percent (range: 13 to 99 percent).

Case finding: female sex worker populations (high prevalence)

An algorithm using a speculum exam and simple microscopy in a high-prevalence (40 percent) population of female sex workers had a sensitivity of 58 percent and PPV of 50 percent. Overall test efficiency reached only 60 percent.

Case management among symptomatic populations

An algorithm including a speculum exam was tested in a study in Jamaica among female STD clients (see Appendix Table A18) where the prevalence of chlamydia/gonorrhea was 32 percent (Behets et al. 1995). Among this population, where the tool was used to manage cases among symptomatic women who were specifically seeking treatment for urogenital complaints, such an algorithm performed much better, yielding a sensitivity of 73 percent, specificity of 56 percent, and PPV of 43 percent. Nevertheless, more than 50 percent of women identified by the algorithm as having chlamydia/gonorrhea were, in fact, not infected. Overall test efficiency was 61 percent.

The tool tested by Germain and colleagues among female sex workers was also applied to a subpopulation of the sample that was symptomatic (Germain et al. 1997). Doing so increased the sensitivity (from 58 to 68 percent), but decreased the specificity (from 61 to 39 percent), leaving the PPV the same for this symptomatic group (49 percent) as for the larger population of symptomatic and asymptomatic female sex workers (50 percent).

Tools Including Risk Factors

Case finding: routine clinic and general populations (moderate prevalence)

Six of the studies reviewed among routine clinic and general populations tested 15 different tools that included combinations of questions regarding risk factors (see Appendix Table A19). In meta-analysis, the PPV was 13 percent. The algorithms or tools achieved PPVs ranging from 0 to 66 percent, with only one having a PPV greater than 20 percent. Sensitivity varied widely, ranging from 0 to 80 percent. Although test efficiency reached 89 percent in meta-analysis, only 22 percent of infected women were identified by the tools, and 87 percent of women identified by the tools as having chlamydia/gonorrhea were not infected.

Case management among symptomatic populations

The two case-management studies among STD clinic clients tested four algorithms that included risk factors (see Appendix Table A19). Sensitivity was greater than 75 percent for each algorithm (meta-analysis: 78 percent); specificity was 50 percent or lower. This resulted, in meta-analysis, in a PPV of 40 percent, a false-positive rate of 60 percent, and a test efficiency of 59 percent. Although these tools identified 78 percent of women with chlamydia/gonorrhea, 60 percent of those identified as having chlamydia/gonorrhea were not infected and received unnecessary treatment.

Risk Scoring

Case finding: routine clinic and general populations (moderate prevalence)

Six of the studies among routine clinic and general populations tested risk-scoring tools as a way to find cases of chlamydia/gonorrhea (see Appendix Table A20). Some included variables obtainable only with speculum exams; others did not. A total of 18 different risk-scoring tools were assessed. Meta-analysis demonstrated a test efficiency of 75 percent. The tools were able to identify 41 percent of those women infected (sensitivity range: 8 to 81 percent). The positive predictive value was 13 percent. All tools tested had a false-positive rate greater than 75 percent—that is, more than three-fourths of the women identified as having chlamydia/gonorrhea through these risk-scoring tools were not infected.

Case finding: female sex worker populations (high prevalence)

One of the analyses among female sex workers also tested an algorithm that included risk scores (see Appendix Table A20). Within the study, the score-driven tool performed better than the simple hierarchical algorithm. Among sex workers in Zaire (Vuylsteke et al. 1993b), a score-driven strategy including variables for demographic factors, symptoms, and signs, and requiring a speculum exam achieved a PPV of 42 percent and sensitivity of 71 percent. This strategy was an improvement over the symptom-only-based algorithm that yielded a PPV of 34 percent and sensitivity of 55 percent (see Appendix Table A17). Test efficiency of the risk score in this population of women with a high prevalence of chlamydia/gonorrhea was still only 61 percent (Appendix Table A20).

Case management among symptomatic populations

In the Jamaican case-management study of STD clinic clients (Behets et al. 1995), as in the Zairian case-finding study among sex workers (Vuylsteke et al. 1993b), the score-driven management option performed better in terms of sensitivity than did the simple algorithm with a speculum exam and the algorithm that included risk factors. The algorithm combined speculum exam and risk scoring of demographic and behavioral factors, including partners' symptoms. This strategy yielded a PPV of 43 percent and a sensitivity of 85 percent. More than half (57 percent) of the women identified by the algorithm as having chlamydia/gonorrhea infection, however, were not actually infected. Overall test efficiency was 56 percent—that is, slightly more than half of the women were correctly identified as having or not having chlamydia/gonorrhea.

Summary

Table 12, below, presents the results of the meta-analysis for the categories discussed above to provide a rough overview of the data from these different studies. The various types of tools used to find cases of chlamydia/gonorrhea infection among general and routine clinic populations of women had sensitivities of 41 percent or lower and PPVs of 13 percent or lower. This result means that almost 87 percent of women identified as having chlamydia/ gonorrhea by means of the tools, would, in fact, not be infected. Overall test efficiency in these populations ranged from 73 to 89 percent because of the low prevalence of infection.

Among female sex workers, the tools performed better for case finding on most measures. Sensitivity ranged from 55 to 71 percent, and PPVs from 34 to 50 percent. Overall test efficiency was lower (53 to 61 percent), however, than that of the tools as used among general and routine clinic populations.

The results from the studies that used the nonlaboratory tools as a way to manage symptomatic women—the purpose for which these tools were originally intended—are also better than those used for case finding among routine clinic and general populations of women. Sensitivity was consistently higher (above 70 percent) for the tools tested in this population, although specificity was below 55 percent. Positive predictive values ranged from 40 percent to 45 percent. Thus, false-positive rates were all above 50 percent—meaning that more than half of the women identified as having chlamydia/gonorrhea by these algorithms would be treated unnecessarily. The highest overall test efficiency achieved was 59 percent.

Table 12 Meta-analysis of nonlaboratory tools used for case finding and case management of chlamydia and gonorrhea

Specification	Prevalence	Sensitivity	Specificity	Positive predictive value	False-positive rate	Test efficiency	(n)
Simple tools without exam							
Case finding							
General and routine clinic populations	**7.1**	101/264 **38.3**	2616/3,443 **76.0**	100/927 **10.8**	827/927 **89.2**	2717/3,707 **73.3**	(3,707)
Female sex workers[a]	**31.0**	208/379 **54.9**	440/843 **52.2**	208/611 **34.0**	403/611 **66.0**	648/1,222 **53.0**	(1,222)
Simple tools with exam							
Case finding							
General and routine clinic populations	**5.3**	134/527 **25.4**	8047/9,368 **85.9**	134/1,435 **9.3**	1,301/1435 **90.7**	8,181/9,875 **82.8**	(9,875)
Female sex workers[a]	**39.8**	84/145 **57.9**	134/219 **61.2**	84/169 **49.7**	85/169 **50.3**	218/364 **59.9**	(364)
Case management	**35.6**	86/121 **71.1**	114/219 **52.1**	86/191 **45.0**	105/191 **55.0**	200/340 **58.8**	(340)
Tools using risk factors							
Case finding							
General and routine clinic populations	**4.9**	70/324 **21.6**	5,780/6,243 **92.6**	70/533 **13.1**	463/533 **86.9**	5,850/6,567 **89.1**	(6,567)
Case management	**30.1**	98/125 **78.4**	145/290 **50.0**	98/243 **40.3**	145/243 **59.7**	243/415 **58.6**	(415)
Risk scoring							
Case finding							
General and routine clinic populations	**7.5**	127/312 **40.7**	2,993/3,828 **78.2**	127/972 **13.1**	845/972 **86.9**	3,120/4140 **75.4**	(4,140)
Female sex workers[a]	**31.0**	269/379 **71.0**	470/843 **55.8**	269/642 **41.9**	373/642 **58.1**	739/1,222 **60.5**	(1,222)
Case management[a]	**35.1**	71/84 **84.5**	62/155 **40.0**	71/164 **43.3**	93/164 **56.7**	133/239 **55.6**	(239)

[a] Because multiple studies are lacking, this specification represents single-study results rather than meta-analysis.

Discussion

When deciding whether a particular strategy for STI control is appropriate and effective in a given context, different standards are employed and different measures take precedence. For instance, presumptive treatment of women whose partners are known to have gonorrhea has only a 30 to 40 percent PPV. In this situation, the predictive value implies treating ten women in order to assure that the three or four who have gonorrhea

infection receive therapy, and most believe that this is a reasonable public health intervention. However, a similar PPV for a case-finding tool to be used among family planning clinic populations may be considered unacceptable, because the number of women who would unnecessarily receive treatment would be much higher. Decisions about whether the results of implementing a certain tool are reasonable and whether overtreatment would cause more harm than good depend on the seriousness of the infection, the number of people who would be overtreated, and the HIV/STI infection patterns and sexual behaviors of the population.

Nonlaboratory tools used to find cases of chlamydia and gonorrhea among mixed symptomatic and asymptomatic patients in routine clinic and general populations generally appear unable to identify those women who are infected. Sensitivity of case-finding tools in populations with a higher prevalence of infection appears generally to reach 50 percent or higher. In all but four instances (out of 52 tools/populations tested[11]) however, the false-positive rate of the tools when used for case finding was 66 percent or higher for all prevalence groups (that is, general and routine clinic populations *and* female sex workers). In concurrence with most authors of the studies reviewed, we conclude that these tools are not effective for use in chlamydia/gonorrhea infection case finding.

The results of the case-management validation studies conducted among symptomatic women show that the case-management tools have what appear to be a consistently higher sensitivity and lower false-positive rate (higher PPVs) than when the tools are used for case finding. Nevertheless, they resulted in presumptive treatment of many women with no infection: More than half of the symptomatic women identified as having chlamydia/ gonorrhea by the algorithms were not infected, and overall test efficiency ranged from 39 to 61 percent. These statistics are disappointing and indicate that the case-management tools are not good diagnostics for chlamydia and gonorrhea. In contexts having a high STI prevalence, where HIV/AIDS is a growing concern, and where chlamydia/gonorrhea case management is needed for a subpopulation at high-risk (for example, STD clinic clients), the primary interest may be in treating the greatest number of cases (that is, high sensitivity). In such situations, even a 50 percent overtreatment is seen as an acceptable consequence by some,

[11] Some of these are the same tools tested in different populations; for example, the Zaire study tested the same algorithm among antenatal clinic clients and among female sex workers.

although others remain unpersuaded. Nonlaboratory tools for chlamydia/gonorrhea are potentially much more useful as case-management tools than as case-finding tools.

Several limitations may have affected the measures of assessment in these studies. On the one hand, the prevalence of chlamydia may have been underestimated. Chlamydia infection may not appear in the cervix, even when it is present in the urethra. A study in Somalia found that 27 percent of infected women showed chlamydia infection only from urethral swabs, not from cervical swabs (Ismail et al. 1990). Because most of the studies reviewed used only cervical specimens to diagnose chlamydia, they may have underestimated the prevalence of chlamydia. Inclusion of urethral diagnosis of chlamydia may affect the results of these studies, although in what direction is not clear.

On the other hand, the usefulness of the tools for case finding was probably overestimated, because the results reflect evaluations of the tools used under ideal conditions. With the exception of the study by Behets, which looked at the usefulness of algorithms in managing cases under field conditions, all others simulated application of the tools. These represent situations in which the algorithms, risk-scoring techniques, and so forth were applied under conditions where clinicians were likely to be well trained in their use—much better trained than clinicians not involved in such studies, who would have less understanding of the tool and be faced with considerably more challenging field conditions. A program that integrated RTI services, including case management, into clinics in the Philippines, for example, found that without facilitative supervision, service providers generally were unable or unwilling to implement the guidelines that they had learned in the training (Costello 1998).

In addition, validity was probably overestimated in studies in which the tools were both developed and tested in the same population. Some of the studies developed the tools and simulated application in the same sample that was used to identify the variables for inclusion in the model (for example, Kaufman et al. 1996; Braddick et al. 1990; Thongkrajai 1996; and Costello Daly et al. 1994). Especially for those tools that included risk factors or risk scoring, efficacy may be artificially high as behavioral and/or demographic risk factors in populations other than the original cohort may be weaker predictors of infection, may have

no association with infection, or may not even be correlated. Even in the same cohort, risk factors may change over time.[12]

V. Implications

Most researchers who have tested algorithms, risk scoring, and other nonlaboratory tools have concluded that these methods perform poorly for case finding of chlamydia and gonorrhea infections. However, the limitations of their use among routine clinic and general populations have not always been apparent to managers and policymakers.

As we can see from the results of studies conducted to date, refinements, such as the addition of risk scoring, produce only marginal improvement in the tools' ability to find cases of chlamydia/gonorrhea among women. The tools correctly identify too few cases and incorrectly identify too many women without infection as being infected, even when they are applied and evaluated for the same populations for which they were developed.

There are reasons why nonlaboratory tools such as algorithms and risk scoring are unlikely ever to be efficient or useful for case finding. If a disease is not common, a test must be both highly sensitive and specific to find most cases without also creating many false positives. For example, if specificity is as high as 90 percent, then 10 percent of individuals *without* the condition will be incorrectly identified as having the condition. If a disease is rare, these false positives will quickly become a larger group than the correctly identified infected women, a situation underscoring the desirability of confirmatory testing in low-prevalence settings.

Enough information exists today to conclude that these tools will not perform better *without simple, low-cost field diagnostics*. A number of STI experts have noted this need (Wasserheit 1989; Behets et al. 1995; Ryan and Holmes 1995; Mayaud et al. 1995; and Vuylsteke et al. 1993b, among others). Although many international agencies have given support to the development of such diagnostics as a priority for STI research, progress has

[12] In a selective screening program for chlamydia among family planning clinics in Wisconsin, for example, an assessment four years after the efforts' initiation found that prevalence of chlamydia had decreased dramatically by approximately 53 percent among both low-risk and high-risk groups. As a result, the criteria identified in 1986 and used since then identified infected patients less efficiently in 1990, effectively doubling the cost per case identified. Consequently, adjustments were made to the program based on findings from the 1990 assessment of variables correlated with infection (Addiss et al. 1993).

been slow. Increased attention to development of simple, low-cost, valid field diagnostics—along with adequate funding for this work—is badly needed.

The question remains, however, *what is to be done in the meantime about chlamydia and gonorrhea in settings where laboratory diagnosis is not available*? The consequences of these infections in terms of morbidity, HIV transmission, and mortality may be grave. Given the imperfection of current tools, more local and national decisionmaking is needed. Consideration of the contexts of different local settings requires not only an epidemiological analysis but also an understanding of programmatic capacity and social processes. No one clear solution exists. "It depends," may be the only universal response we can give to our self-imposed question.

Key among the issues to consider are those related to the women who are classified wrongly by any clinical tool. The proportion of women affected by misdiagnosis is large. Among the 49 tools/populations tested for case finding in routine clinic and general populations, only three reached PPVs greater than 25 percent. The vast majority did not reach even 20 percent, so that even given the best results, for every woman accurately treated for infection, four women would be treated unnecessarily and would be mislabled as infected. Tools used among female sex workers had PPVs of 34, 50, and 42 percent—that is, more than half of the women engaged in high-risk sexual behavior would also be mislabeled as infected. The proportion of women who might fall into the category of false negatives is also substantial. Only 15 out of the 52 tools/populations assessed for their ability to find cases of chlamydia/gonorrhea among moderate- and high-prevalence populations achieved sensitivities greater than 60 percent. Indeed, more than half of the tools were unable to detect even 50 percent of all the women with chlamydia and/or gonorrhea infection. In general and routine clinic populations, tools did not reach even 50 percent sensitivity in meta-analysis, and tools used among sex workers achieved sensitivities of 55, 58, and 71 percent. We consider below the implications of using algorithms, risk scoring, and other tools for finding chlamydia/gonorrhea infection in those infected women who have been missed (false negatives) and those women who have been identified as being infected when they are not (false positives).

What are the consequences for women who have been identified as uninfected but who may be infected? Most obviously, they do not receive treatment for a curable

infection(s) and face potentially serious consequences. In some ways, the results for the women who are infected but not identified as such are the same as before any service was provided to them. However, because these women have been screened, they and their service providers may feel a false sense of security. This feeling has consequent implications for advice and decisionmaking regarding STI prevention, contraceptive-method selection, partner communication, and prenatal and delivery care. For instance, where IUDs are commonly used, women falsely identified as not infected may receive a contraceptive that is contraindicated for them.

What, too, are the consequences of mislabeling women as infected with an STI when they are not? First, those women will receive drugs that they do not require. Overuse of antibiotics may cause resistant strains of infectious organisms to develop in the community that are not susceptible to treatment with available drugs. In addition, all drugs have risks of side effects, including allergies and other, more serious reactions.

In discussions about the pros and cons of nonlaboratory strategies, the question of what mislabeling means to the individual is rarely considered. What are the consequences of telling a woman that she has a sexually transmitted infection when she does not? They are very different from what she would experience were she told that she had pneumonia or malaria. First, in many contexts, social stigma is associated with having a sexually transmitted infection. Second, by definition, having this sort of condition means that either the woman or her partner has had sexual contact with someone outside the marriage or union. If the woman has had such contact, does she tell her husband (since he would also need treatment) and acknowledge that she has had a relationship with someone else? If she has not, does she, making the assumption that the infection could only come from her husband, confront him and accuse him of infidelity? Does she say nothing, but insist on condom use in the future? Is insisting on condom use something that is possible for her, given the power differentials in the relationship? What does a misdiagnosis do in terms of undermining a woman's trust in her partner and their relationship, or of his trust in her?

The optimum contents of the messages that should accompany the results derived from using these tools have not been fully explored. Because the tools are imperfect, the message to be relayed is complex; the woman may be told that she may have some kind of an infection that may or may not be sexually transmitted. In a larger sense, the issue of client–

provider communication about sensitive topics has been woefully neglected by the reproductive health and population field. Thus, many service providers, aware of the complexities of STI counseling, are confused about how to handle such situations. For example, the clinicians working on an STI study in Hue, Vietnam, found that although they had treated many women for presumed infections in the past, that study for the first time made a confirmed laboratory diagnosis of trichomoniasis possible. With a confirmed STI diagnosis, clinicians had to face the difficult challenge of specific counseling and partner notification (Phan Thi Lien et al. 1998).

How do we counsel women that they might have an STI but probably have an endogenous infection? How do we tell a woman that if she does have an STI, her partner/s may have one as well? When the provider does not know whether a woman has an STI, the appropriate counseling may be to tell her she is being treated for a range of infections, some of which are sexually transmitted, but many of which are not. The complexity of this counseling message is an operational issue that has largely gone unevaluated. Information that is available indicates that providers often do not tell a woman that she has an STI unless they are absolutely sure and, even if they are sure, the provider may not inform the woman because the topic is difficult or uncomfortable to discuss (Iskandar et al. 1997). In some instances, providers choose not to communicate this possibility, either because they are not comfortable with issues involving sexual behavior or because they deliberately seek to avoid the social implications for the couple. However, withholding full information about the medical condition of a patient and treatment choices may be ethically unacceptable.

Partner nofitication is equally complicated. Discussing an actual or suspected sexually transmitted infection with a partner is not easy in the best of circumstances, and in the worst, can be physically harmful to the woman, or can lead to divorce or dissolution of a relationship. A husband whose wife tells him that he must be treated for an infection, or that she would like to use a condom always has the option of denial and of accusing her of having an extramarital liaison. In contexts where women's sexuality is strictly controlled, a woman who tells her husband that she has an STI may be at great risk. Clearly, women are better off knowing about a real infection, but the counseling, course of action, and partner notification issues are complex and are underexamined.

Partner-notification strategies in the reproductive health and family planning field are still being explored. In many settings, practitioners are ill-equipped to conduct such programs in a manner that is supportive of women. The implications of this weakness are troubling in those situations where we can confirm infection with laboratory diagnosis. However, where clinicians are relying on nonlaboratory management tools, an even greater need exists for consideration of the implications. What does "partner notification" mean in the context of syndromic management?

VI. Conclusion

We are thus left with a thorny situation. The consensus is that reproductive tract infections constitute a widespread public health problem requiring attention. The problem is made particularly acute by sexually transmitted infections' contribution to HIV transmission and the urgency of slowing the HIV/AIDS pandemic. Many governments, donors, and nongovernmental organizations feel the necessity of doing something now to address RTIs in service delivery. Some propose that basing services in low-resource settings on nonlaboratory tools such as algorithms and risk scores to find and treat cases, if not a perfect strategy, must be better than doing nothing. Others contend that doing so may, in fact, be worse than doing nothing. As is shown here, research to date suggests that these tools are severely limited.

On the one hand, imperfect tools exist that perform poorly when used to find cases in populations with a moderate prevalence of these infections and perform better at managing cases among symptomatic women (but that still presumptively treat a large proportion of women who are not infected). On the other hand, a broad range of regional, national, and local settings must be considered that have vastly different contextual variables regarding sexually transmitted infections, HIV/AIDS prevalence, sexual behavior patterns, health-seeking behavior, and programmatic capacity. Clearly, there is no single solution. Case management of chlamydia/gonorrhea might be a smart policy decision in an STD clinic in a community with high prevalence, but may generate too few identified cases and too much overtreatment in maternal and child health or family planning clinics in any circumstances. An acute need exists for informed policy choices that take local contexts into account.

Essentially, two tasks must be faced: (1) to manage simply, safely, and cheaply the common problem of symptomatic vaginal infection; and (2) to detect and treat cervical infection in those regions and among those populations for whom the prevalence is high enough to justify the effort. What we see from this review is that accomplishment of the first task is not a path to resolution of the second.

The following challenges are evident for policymakers, researchers, and program managers. We view these items as starting points for further discussion and exploration.

(1) Depending on the prevalence of chlamydia and gonorrhea, different responses will be appropriate. In some settings, where the prevalence of chlamydia/gonorrhea is too low to be viewed as a public health concern, it is probably best to abandon attempts to find cases of cervical infection among women who are not presenting for treatment of symptoms. In such settings, trying to distinguish chlamydia/gonorrhea among symptomatic women by using algorithms, risk scores, and other nonlaboratory tools may also not be worthwhile.

Where the prevalence of chlamydia/gonorrhea is very high, more radical measures such as periodic presumptive treatment form part of the options that policymakers should consider. For instance, in Rakai, Uganda, a randomized trial of intensive STI control via presumptive treatment for women during pregnancy achieved declines in the prevalence of chlamydia and gonorrhea (as well as in that of trichomoniasis and bacterial vaginosis) in the intervention area (Gray et al. 1998).

In settings having a medium prevalence of these infections, a mixture of targeted strategies such as contact tracing and selective laboratory screening may be the appropriate response. What levels of prevalence and what contextual variables should trigger the adoption of one option over another is a topic for further research and policy analysis.

(2) A central question is whether using nonlaboratory case-finding or case-management tools is a better approach than simply following current routine practice for identifying and treating chlamydia and gonorrhea in reproductive health service settings. From the results of the studies reviewed in this paper, the tools are clearly shown to be ineffective for finding cases of chlamydia/gonorrhea. In terms of case management, many community-based clinics already rely on some ad hoc

management of symptomatic patients—either referring them to a higher level of care or prescribing available antibiotics. Others do not. Does using algorithms, risk scores, and other nonlaboratory tools add value to current practice? Or does it do more harm than good? Findings from the Hue study indicate that in central Vietnam, although use of flowcharts for managing symptomatic women significantly reduced overtreatment of vaginal infections, the flowchart performed as poorly as did current clinical practice for cervical infection (chlamydia and gonorrhea) (Phan Thi Lien et al. 1998).

(3) The potential for improving training and supervision can be one reason to standardize case management. Where effective case-management tools are adopted, the strategy can provide standard guidelines and procedures that support clinicians better in helping symptomatic women and provide more consistent data for monitoring. Training in such systems may also provide a vehicle for broadening the providers' views of their own roles beyond the reflexive prescription of antibiotics. Clearly, no one case-management tool can serve this purpose across settings. The content of the case-management guidelines must be specific to the local and national context.

(4) In all program applications of nonlaboratory approaches, training and supervision should be focused on supporting providers in discussing intimate topics, including sexual behavior. The probability that an STI management decision or diagnosis is correct must also be broached. Providers must be able to provide support in assisting a woman to make her own decisions regarding treatment and prevention of infection, and contraceptive choice, and to offer assistance and support, if the woman wants it, in notifying and counseling her partner(s). Without a process of information exchange regarding these issues—particularly the health implications of a woman's and her partner's sexual behavior—the usefulness of any STI management strategy is undermined. Although experiments in incorporating providers' attention to sexuality into discourse with clients have been tried successfully in a few settings (Becker and Leitman 1997), the vast majority of reproductive health settings lack this capacity. The question of how best to support providers in discussing intimate topics and changing the nature and content of their conversations with clients needs further research.

(5) Because of the disappointing results of the algorithms, risk scores, and other tools for finding chlamydia and gonorrhea among women, case finding could, with tools currently available, be centered on finding symptomatic men, improving counseling for men and partner notification, and improving counseling and treatment among their female partners.

(6) Alternative service-delivery options that could be explored include the following:

   a) Because gonorrhea appears to show consistently lower prevalence than chlamydia, the effects could be tested of dropping the gonorrhea treatment from the empiric treatment recommendations as a means of lowering the cost and danger of overtreatment when managing clients presenting with symptoms.

   b) A "two-visit" algorithm could be tested according to which symptomatic women first receive treatment for vaginitis and then revisit for persistent symptoms. This strategy may not be feasible in all settings, but should be evaluated in the private sector where, at least in parts of Asia and Latin America, most care is received and revisits are the norm.

   c) In some settings, these management strategies might be of greater benefit when used in conjunction with laboratory capacity, or eventually with low-cost field diagnostic tests in a broader range of settings.

(7) All research assessing the usefulness of management tools based on signs, symptoms, and social and behavioral risk factors should include a scientifically adequate validation component to ensure that research benefits directly the populations among whom the work is conducted. At the same time, such validation will add to the core of scientific information enabling more informed discussion of this difficult matter. Research on other related aspects of case management, such as developing appropriate counseling messages, may not require definitive diagnosis of infection per se, but should follow ethical guidelines that ensure women's confidentiality and safety.

(8) Finally, simple, accurate, rapid, low-cost diagnostics are desperately needed. Finding them is among the most urgent areas for continued research.

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APPENDIX:

Tables A1–A20:

Screening Criteria for Signs, Symptoms, Simple Tests, and Risk Factors Used for Identifying Case Status of Gonorrhea and Chlamydia, and Nonlaboratory Tools Used to Identify Case Status

Tables A1-A16 Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A1 Symptom: Vaginal discharge, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Bourgeois et al. 1996	Gabon		13.5	Antenatal clinic	20/26 76.9	62/166 37.3	20/124 16.1	104/124 83.9	82/192 42.7	(192)
Braddick et al. 1990	Kenya		15.7	Antenatal clinic	8/28 28.6	107/150 71.3	8/51 15.7	43/51 84.3	115/178 64.6	(178)
Kaufman et al. 1996	China, rural	Abnormal	6.1	General population	27/97 27.8	804/1,475 54.5	27/698 3.9	671/698 96.1	831/1,572 52.9	(1,572)
Mayaud et al. 1995	Tanzania, rural		8.4	Antenatal clinic	13/81 16.0	742/883 84.0	13/154 8.4	141/154 91.6	755/964 78.3	(964)
Ronsmans et al. 1996[a]	Turkey	Profuse	4.9	General population	8/34 23.5	588/661 89.0	8/81 9.9	73/81 90.1	596/695 85.8	(695)
Ronsmans et al. 1996[a,b]	Turkey	Abnormal	4.9	General population	5/34 14.7	554/661 83.8	5/112 4.5	107/112 95.5	559/695 80.4	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	6/31 19.4	212/260 81.5	6/54 11.1	48/54 88.9	218/291 74.9	(291)
Thongkrajai 1996[a]	Thailand		3.3	MCH/FP	1/26 3.8	739/765 96.6	1/27 3.7	26/27 96.3	740/791 93.6	(791)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	27/75 36.0	846/1,085 78.0	27/266 10.2	239/266 89.8	873/1,160 75.3	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**6.8**		**110/398 27.6**	**4,100/5,445 75.3**	**110/1,455 7.6**	**1,345/1,455 92.4**	**4,210/5,843 72.1**	**(5,843)**
Germain et al. 1997	Benin		48.4	Female sex workers	60/177 33.9	148/189 78.3	60/101 59.4	41/101 40.6	208/366 56.8	(366)
Vuylsteke et al. 1993b	Zaire		31.0	Female sex workers	102/379 26.9	648/843 76.9	102/297 3.4	195/297 65.7	750/1,222 61.4	(1,222)
Meta-analysis: Female sex workers			**35.0**		**162/556 29.1**	**796/1,032 77.1**	**162/398 40.7**	**236/398 59.3**	**958/1,588 60.3**	**(1,588)**

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of gonococcal cervicitis (GC) only included in meta-analysis to produce highest screening utility.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A2a Symptom: Vaginal itch, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Kaufman et al. 1996	China, rural		5.9	General population	38/97 39.2	841/1,547 54.4	38/744 5.1	706/744 94.9	879/1,644 53.5	(1,644)
Ronsmans 1996[a]	Turkey		4.9	General population	5/34 14.7	554/661 83.8	5/112 4.5	107/112 95.5	559/695 80.4	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	4/31 12.9	214/260 82.3	4/50 8.0	46/50 92.0	218/291 74.9	(291)
Thongkrajai 1996[a]	Thailand		3.3	MCH/FP	1/26 3.8	740/765 96.7	1/26 3.8	25/26 96.2	741/791 96.9	(791)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	22/75 29.3	876/1,085 80.7	22/231 9.5	209/231 90.5	898/1,160 77.4	(1,160)
Meta-analysis: General, family planning and antenatal clinic populations			**5.7**		**70/263 26.6**	**3,225/4,318 74.7**	**70/1,163 6.0**	**1,093/1,163 94.0**	**3,295/4,581 71.9**	**(4,581)**
Vuylsteke 1993b	Zaire		31.0	Female sex workers	124/379 32.7	574/843 68.1	124/393 31.6	269/393 68.4	698/1,222 57.1	(1,222)

Table A2b Symptom: Malodorous vaginal discharge, by study, according to selected measures

Bourgeois et al. 1996	Gabon	Malodorous (sign)	13.5	Antenatal clinic	3/26 11.5	155/166 93.4	3/14 21.4	11/14 78.6	158/192 82.3	(192)
Kaufman et al. 1996[a]	China, rural	Malodorous (sign)	5.4	General population	31/90 34.4	965/1,554 62.1	31/620 5.0	589/620 95.0	996/1,644 60.6	(1,644)
Kaufman et al. 1996[b,c]	China, rural	Malodorous (sign)	0.4	General population	3/7 42.9	890/1,637 54.4	3/750 0.4	747/750 99.6	893/1,644 54.3	(1,644)
Ronsmans at al. 1996[a]	Turkey	Anine odor (sign)	4.9	General population	6/34 17.6	555/661 84.0	6/112 5.4	106/112 94.6	561/695 80.7	(695)
Ronsmans et al. 1996[a,b]	Turkey	Malodorous (symptom)	4.9	General population	8/34 23.5	495/661 74.9	8/174 4.6	166/174 95.4	503/695 72.4	(695)
Meta-analysis: General, family planning and antenatal clinic populations			**5.9**		**40/150 26.7**	**1,675/2,381 70.4**	**40/746 5.4**	**706/746 94.6**	**1,715/2,531 67.8**	**(2,531)**

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A2c Symptom: Yellow-green vaginal discharge, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Bourgeois et al. 1996	Gabon	Yellow-green (sign)	13.5	Antenatal clinic	4/26 15.4	141/166 84.9	4/29 13.8	25/29 86.2	145/192 75.5	(192)
Braddick et al. 1990	Kenya	Yellow-green (sign)	15.7	Antenatal clinic	6/28 21.4	134/150 89.3	6/22 27.3	16/22 72.7	140/178 78.7	(178)
Kaufman et al. 1996[a]	China, rural	Yellow-green bloody (sign)	5.4	General population	34/90 37.8	1,021/1,554 65.7	34/567 6.0	533/567 94.0	1,055/1,644 64.2	(1,644)
Kaufman et al. 1996[b,c]	China, rural	Yellow-green bloody (sign)	0.4	General population	5/7 71.4	1,017/1,637 62.1	5/625 0.8	620/625 99.2	1,023/1,644 62.2	(1,644)
Ronsmans et al. 1996[a]	Turkey	Yellow-green (symptom)	4.9	General population	4/34 11.8	576/661 87.1	4/89 4.5	85/89 95.5	580/695 83.5	(695)
Meta-analysis: General, family planning and antenatal clinic populations			**6.6**		**48/178 27.0**	**1,872/2,531 74.0**	**48/707 6.8**	**659/707 93.2**	**1,920/2,709 70.9**	**(2,709)**

Table A2d Symptom: Clumped, thick, or frothy vaginal discharge, by study, according to selected measures

Braddick et al. 1990	Kenya	Frothy (sign)	15.7	Antenatal clinic	10/28 35.7	130/150 86.7	10/30 33.3	20/30 66.7	140/178 78.7	(178)
Kaufman et al. 1996[a]	China, rural	Thick (sign)	5.4	General population	46/90 51.1	730/1,554 47.0	96/920 10.4	824/920 89.6	776/1,644 47.2	(1,644)
Kaufman et al. 1996[b,c]	China, rural	Thick (sign)	0.4	General population	6/7 85.7	443/1,637 27.1	6/1,200 0.5	1,194/1,200 99.5	449/1,644 27.3	(1,644)
Ronsmans et al. 1996[a]	Turkey	Clumped (sign)	4.9	General population	3/34 8.8	631/661 95.5	3/33 9.1	30/33 90.9	634/695 91.2	(695)
Meta-analysis: General, family planning antenatal clinic populations			**6.0**		**59/152 38.8**	**1,491/2,365 63.0**	**109/983 11.1**	**874/983 88.9**	**1,550/2,517 61.6**	**(2,517)**

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only. [d] Screening criteria numerators and denominators estimated from marginal data, may reflect small (n = 1 or 2) errors, but would not affect the whole percentage estimates.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A3 Symptom: Abdominal/lower abdominal pain, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Bourgeois et al. 1996	Gabon		13.5	Antenatal clinic	10/26 38.5	100/166 60.2%	10/76 13.2	66/76 86.8	110/192 57.3	(192)
Braddick et al. 1990	Kenya		15.7	Antenatal clinic	11/28 39.3	65/150 43.3	11/76 14.5	65/76 85.5	96/178 53.9	(178)
Kaufman et al. 1996	China, rural		5.9	General population	11/97 11.3	1,465/1,547 94.7	11/93 11.8	82/93 88.2	1,476/1,644 89.8	(1,644)
Mayaud et al. 1995	Tanzania, rural		8.4	Antenatal clinic	44/81 54.3	468/883 53.0	44/459 9.6	415/459 90.4	512/964 53.1	(964)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	19/34 55.9	298/661 45.1	19/382 5.0	363/382 95.0	317/695 45.6	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	11/31 35.5	162/260 62.3	11/109 10.1	98/109 89.9	173/291 59.5	(291)
Thongkrajai 1996[a]	Thailand		3.3	MCH/FP	2/26 7.7	543/765 71.0	2/224 0.9	222/224 99.1	545/791 68.9	(791)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	32/75 42.7	732/1,085 67.5	32/385 8.3	353/385 91.7	764/1,160 65.9	(1,160)
Meta-analysis: General, family planning and antenatal clinic populations			**6.7**		**140/398 35.2**	**3,833/5,517 69.5**	**144/1,808 8.0**	**1,664/1,808 92.0**	**3,993/5,915 67.5**	**(5,915)**
Vuylsteke et al. 1993b	Zaire		31.0	Female sex workers	168/379 44.3	513/843 60.9	168/498 33.7	330/498 66.3	681/1,222 55.7	(1,222)
Meta-analysis: Female sex workers			**31.0**		**168/379 44.3**	**513/843 60.9**	**168/498 33.7**	**330/498 66.3**	**681/1,222 55.7**	**(1,222)**

[a] Chlamydia only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A4 Sign: Vaginal discharge, by study, according to selected measures

Study (authors/dates)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases percemt	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Bourgeois et al. 1996	Gabon		13.5	Antenatal clinic	18/26 69.2	53/166 31.9	18/121 14.9	103/121 85.1	71/192 37.0	(192)
Braddick et al. 1990	Kenya	Profuse	15.7	Antenatal clinic	10/28 35.7	112/150 74.7	10/48 20.8	38/48 79.2	122/178 68.5	(178)
Herrmann et al. 1996[a]	Nicaragua		5.0	Antenatal clinic, family planning, general clinics	35/46 76.1	271/875 31.0	35/639 5.5	604/639 94.5	306/921 33.2	(921)
Kaufman et al. 1996[a]	China, rural		5.4	General population	80/90 88.9	301/1,544 19.5	80/1,333 6.0	1,253/1,333 94.0	381/1,644 23.2	(1,644)
Kaufman et al. 1996[b,c]	China, rural		0.4	General population	6/7 85.7	143/1,637 8.7	6/1,500 0.4	1,494/1,500 99.6	1,49/1,644 9.1	(1,644)
Mayaud et al. 1995	Tanzania, rural		8.4	Antenatal clinic	39/81 48.1	574/883 65.0	39/348 11.2	309/348 88.8	613/964 63.6	(964)
Ronsmans et al. 1996[a]	Turkey	Profuse	4.9	General population	1/34 2.9	634/661 95.9	1/28 3.6	27/28 96.4	635/695 91.4	(695)
Ronsmans et al. 1996[a,b]	Turkey	Abnormal	4.9	General population	18/34 52.9	329/661 49.8	18/350 5.1	332/350 94.9	347/695 49.9	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	11/31 35.5	177/260 68.1	11/94 11.7	83/94 88.3	188/291 64.6	(291)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	50/75 66.7	558/1,085 51.4	50/577 8.7	527/577 91.3	608/1,160 52.4	(1,160)
Meta-analysis: General, family planning and antenatal clinic populations			**6.8**		**244/411 59.4**	**2,680/5,624 47.7**	**244/3,188 7.7**	**2,944/3,188 92.3**	**2,924/6,045 48.4**	**(6,045)**
Germain et al. 1997	Benin		48.4	Female sex workers	102/177 57.6	105/189 55.6	102/186 54.8	84/186 45.2	189/366 51.6	(366)
Vuylsteke et al. 1993b	Zaire		31.0	Female sex workers	240/379 63.3	424/843 50.3	240/659 36.4	419/659 63.6	664/1,222 54.3	(1,222)
Meta-analysis: Female sex workers			**35.0**		**342/556 61.5**	**529/1,032 51.3**	**342/845 40.5**	**503/845 59.5**	**853/1,588 53.7**	**(1,588)**

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A5 Sign: Mucopus, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Acosta-Cazares et al. 1996[a]	Mexico, rural		7.3	General clinic	19/41 46.3	513/518 99.0	19/24 79.2	5/24 20.8	532/559 95.2	(559)
Braddick et al. 1990	Kenya		15.7	Antenatal clinic	17/28 60.7	119/150 79.3	17/48 35.4	31/48 64.6	136/178 76.4	(178)
Herrmann et al. 1996[a]	Nicaragua		5.0	Antenatal clinic, family planning, general clinic	23/46 50.0	748/876 85.4	23/151 15.2	128/151 84.8	771/922 83.6	(922)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	4/34 11.8	566/661 85.6	4/99 4.0	95/99 96.0	570/695 82.0	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	5/31 16.1	244/260 93.8	5/21 23.8	16/21 76.2	249/291 85.6	(291)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	1/75 1.3	1,079/1,085 99.4	1/8 12.5	7/8 87.5	1,080/1,160 93.1	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			6.7		**69/255 27.1**	**3,269/3,550 92.1**	**69/351 19.7**	**282/351 80.3**	**3,338/3,805 87.7**	**(3,805)**
Vuylsteke et al. 1993b	Zaire		31.0	Female sex workers	51/379 13.5	824/843 97.7	51/70 72.9	19/70 27.1	875/1,222 71.6	(1,222)
Meta-analysis: Female sex workers			**31.0**		**51/379 13.5**	**824/843 97.7**	**51/70 72.9**	**19/70 27.1**	**875/1,222 71.6**	**(1,222)**
Behets et al. 1995	Jamaica		31.9	With sexually transmitted disease	59/81 72.8	96/173 55.5	59/136 43.4	77/136 56.6	155/254 61.0	(254)

[a] Chlamydia only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A6 Sign: Cervical friability, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specifictiy Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Acosta-Cazares et al. 1996[a]	Mexico, rural		7.3	General clinic	31/41 75.6	329/518 63.5	31/220 14.1	189/220 85.9	365/559 65.3	(559)
Bourgeois et al. 1996	Gabon		13.5	Antenatal clinic	3/26 11.5	160/166 96.4	3/9 33.3	6/9 66.7	163/192 84.9	(192)
Braddick et al. 1990	Kenya		15.7	Antenatal clinic	12/28 42.9	123/150 82.0	12/39 30.8	27/39 69.2	135/178 75.8	(178)
Kaufman et al. 1996[a]	China, rural		5.4	General population	30/90 33.3	1,084/1,544 70.2	30/500 6.0	470/500 94.0	1,114/1,644 67.8	(1,644)
Kaufman et al. 1996[b,c]	China, rural		0.4	General population	2/7 28.6	1,139/1,637 69.6	2/500 0.4	498/500 99.6	1,141/1,644 69.4	(1,644)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	12/34 35.3	468/661 70.8	12/205 5.9	193/205 94.1	480/695 69.1	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	12/31 38.7	200/260 76.9	12/72 16.7	60/72 83.3	212/291 72.9	(291)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	5/75 6.7	1,033/1,085 95.2	5/57 8.8	52/57 91.2	1,038/1,160 89.5	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**6.9**		**105/325 32.3**	**3,397/4,384 77.5**	**105/1,102 9.5**	**997/1,102 90.5**	**3,507/4,719 74.3**	**(4,719)**
Vuylsteke et al. 1993b	Zaire		31.0	Female sex workers	27/379 7.1	827/843 98.1	27/43 62.8	16/43 37.2	854/1,222 69.9	(1,222)
Meta-analysis: Female sex workers			**31.0**		**27/379 7.1**	**827/843 98.1**	**27/43 62.8**	**16/43 37.2**	**854/1,222 69.9**	**(1,222)**

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A7 Sign: Cervical Ectopy, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Herrmann et al. 1996[a]	Nicaragua		5.0	Antenatal clinic, family planning, general clinic	7/46 15.2	835/880 94.9	7/52 13.5	45/52 86.5	862/926 93.1	(926)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	9/34 26.5	595/661 90.0	9/75 12.0	66/75 88.0	604/695 86.9	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	4/31 12.9	235/260 90.4	4/29 13.8	25/29 86.2	239/291 82.1	(291)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	3/75 4.0	1,061/1,085 97.8	3/27 11.1	24/27 88.9	1,064/1,160 91.7	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**6.1**		**23/186 12.4**	**2,726/2,886 94.5**	**23/183 12.6**	**160/183 87.4**	**2,769/3,072 90.1**	**(3,072)**
Vuylsteke et al. 1993b	Zaire		31.0	Female sex workers	44/379 11.6	783/843 92.9	44/104 42.3	60/104 57.7	827/1,222 67.7	(1,222)

[a] Chlamydia only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A8 Simple test: Leucocyte, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Thongkrajai 1996[a]	Thailand	100 cell/ml	3.3	MCH/FP	1/26 3.8	552/765 72.2	1/214 0.5	213/214 99.5	553/791 69.9	(791)
Vuylsteke et al. 1993b	Zaire	~75 PMNs /μL	6.5	Antenatal clinic	16/75 21.3	939/1,085 86.5	14/160 8.7	146/160 91.3	955/1,160 82.3	(1,160)
Vuylsteke et al. 1993b[b]	Zaire	~500 PMNs/μL	6.5	Antenatal clinic	30/75 40.0	889/1,085 81.9	30/226 13.3	196/226 86.7	919/1,160 79.2	(1,160)
Vuylsteke et al. 1993b[b]	Zaire	~25 PMNs/μL	6.5	Antenatal clinic	14/75 18.7	924/1,085 85.2	14/175 8.0	161/175 92.0	938/1,160 80.9	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**5.2**		**17/101 16.8**	**1,491/1,850 80.6**	**15/374 4.0**	**359/374 96.0**	**1,508/1,951 77.3**	**(1,951)**

PMNs = Polymorphonuclear leukocytes.

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single-study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A9 Simple test: Polymorphonuclear leukocytes, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Bourgeois et al. 1996	Gabon	PMN positive	13.5	Antenatal clinic	13/26 50.0	119/166 71.7	13/60 21.7	47/60 78.3	132/192 68.8	(192)
Kaufman et al. 1996[a]	China, rural	≥30 gram stain	5.4	General population	6/90 6.7	1,493/1,554 96.1	6/67 9.0	61/67 91.0	1,499/1,644 91.2	(1,644)
Kaufman et al. 1996[a,b]	China, rural	≥10 wet mount	5.4	General population	18/90 20.0	1,212/1,554 78.0	18/360 5.0	342/360 95.0	1,230/1,644 74.8	(1,644)
Kaufman et al. 1996[a,b]	China, rural	≥30 wet mount	5.4	General population	2/90 2.2	1,489/1,554 95.8	2/67 3.0	65/67 97.0	1,491/1,644 90.7	(1,644)
Kaufman et al. 1996[a,b]	China, rural	≥10 gram stain	5.4	General population	35/90 38.9	1,089/1,554 70.1	35/500 7.0	465/500 93.0	1,124/1,644 68.4	(1,644)
Kaufman et al. 1996[b,c]	China, rural	≥10 wet mount	0.4	General population	4/7 57.1	1,241/1,637 75.8	4/400 1.0	396/400 99.0	1,245/1,644 75.7	(1,644)
Kaufman et al. 1996[b,c]	China, rural	≥30 wet mount	0.4	General population	1/7 14.3	1,538/1,637 94.0	1/100 1.0	99/100 99.0	1,539/1,644 93.6	(1,644)
Kaufman et al. 1996[b,c]	China, rural	≥10 gram stain	0.4	General population	2/7 28.6	972/1,637 59.4	2/667 0.3	665/667 99.7	974/1,644 59.2	(1,644)
Mayaud et al. 1995	Tanzania, rural	>10/HPF	8.4	Antenatal clinic	47/81 58.0	512/883 58.0	47/418 11.2	371/418 88.8	559/964 58.0	(964)
Ronsmans et al. 1996[a]	Turkey	≥30/HPF	4.9	General population	16/34 47.1	505/661 76.4	16/172 9.3	156/172 90.7	521/695 75.0	(695)
Vuylsteke et al. 1993b	Zaire	≥10/HPF cervical smear	6.5	Antenatal clinic	31/75 41.3	824/1,085 75.9	31/292 10.6	261/292 89.4	855/1,160 73.7	(1,160)
Vuylsteke et al. 1993b[b]	Zaire	≥10/HPF vaginal smear	6.5	Antenatal clinic	55/75 73.3	553/1,085 51.0	55/587 9.4	532/587 90.6	608/1,160 52.4	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**6.6**		**113/306 36.9**	**3,453/4,349 79.4**	**113/1,009 11.2**	**896/1,009 88.8**	**3,566/4,655 76.6**	**(4,655)**
Germain et al. 1997	Benin	>10 PMN/field urine	48.4	Female sex workers	64/177 36.2	147/189 77.8	64/106 60.4	42/106 39.6	211/366 57.7	(366)
Germain et al. 1997[b]	Benin	>10 PMN/field cervical discharge	48.4	Female sex workers	30/177 16.9	176/189 93.1	30/43 69.8	13/43 30.2	206/366 56.3	(366)
Meta-analysis: Female sex workers			**48.4**		**64/177 36.2**	**147/189 77.8**	**64/106 60.4**	**42/106 39.6**	**211/366 57.7**	**(366)**

HPF = High power field. PMN = Polymorphonuclear leukocyte.

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest s screening utility. [c] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A10 Risk factor: Young age, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Acosta-Cazares et al. 1996[a]	Mexico, rural	<25	7.3	General clinic	18/41 43.9	392/518 75.7	18/144 12.5	126/144 87.5	410/559 73.3	(559)
Costello Daly et al. 1994[c]	Kenya	<25	3.2	Family planning	71/129 55.0	2,089/3,883 53.8	71/1,865 3.8	1,794/1,865 96.2	2,160/4,012 53.8	(4,012)
Herrmann et al. 1996[a]	Nicaragua	<20	4.3	Antenatal clinic, family planning, general clinic	10/37 27.0	711/826 86.1	10/125 8.0	115/125 92.0	721/863 83.5	(863)
Herrmann et al. 1996[a,b]	Nicaragua	<25	4.3	Antenatal clinic, family planning, general clinic	26/37 70.3	488/826 59.1	26/364 7.1	338/364 92.9	514/863 59.6	(863)
Mayaud et al. 1995	Tanzania, rural	<25	8.4	Antenatal clinic	51/81 63.0	415/883 47.0	51/519 9.8	468/519 90.2	466/964 48.3	(964)
Thomas et al. 1994	Kenya	<25	10.8	Antenatal clinic	23/31 74.2	99/260 38.1	23/184 12.5	161/184 87.5	122/291 41.9	(291)
Thongkrajai 1996[a]	Thailand	<25	3.3	MCH/FP	2/26 7.7	429/765 56.1	2/338 0.6	336/338 99.4	431/791 54.5	(791)
Ronsmans et al. 1996[a]	Turkey	<21	4.9	General population	4/34 11.8	646/661 97.7	4/19 21.1	15/19 78.9	650/695 93.5	(695)
Vuylsteke et al. 1993b	Zaire	<25	6.5	Antenatal clinic	56/75 74.7	563/1,085 51.9	56/578 9.7	522/578 90.3	619/1,160 53.4	(1,160)
Meta-analysis: General, family planning and antenatal clinic populations			**4.9**		**235/454 51.8**	**5,344/8,881 60.2**	**235/3,772 6.2**	**3,537/3,772 93.8**	**5,579/9,335 59.8**	**(9,335)**
Behets et al. 1995	Jamaica	<21	33.7	With sexually transmitted disease	97/244 39.8	367/480 76.5	97/210 46.2	113/210 53.8	464/724 64.1	(724)
Coetzee and Mathews 1998	South Africa	< 25	27.3	With sexually transmitted disease	12/44 27.3	94/117 80.3	12/35 34.3	23/35 65.7	106/161 65.8	(161)
Meta-analysis: Case management			**32.5**		**109/288 37.9**	**461/597 77.2**	**109/245 44.5**	**136/245 55.5**	**570/885 64.4**	**(885)**
Vuylsteke et al. 1993b	Zaire	<25	31.0	Female sex workers	243/379 64.1	488/843 57.9	243/597 40.7	354/597 59.3	731/1,222 59.8	(1,222)
Meta-analysis: Female sex workers			**31.0**		**243/379 64.1**	**488/843 57.9**	**243/597 40.7**	**354/597 59.3**	**731/1,222 59.8**	**(1,222)**

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A11 Risk factor: Unmarried, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Acosta-Cazares et al. 1996[a]	Mexico, rural		7.3	General clinic	14/41 34.1	505/518 97.5	14/27 51.9	13/27 48.1	519/559 92.8	(559)
Bourgeois et al. 1996	Gabon		13.5	Antenatal clinic	21/26 80.8	35/166 21.1	21/152 13.8	131/152 86.2	56/192 29.2	(192)
Braddick et al. 1990	Kenya		16.2	Antenatal clinic	14/28 50.0	107/145 73.8	14/52 26.9	38/52 73.1	121/173 69.9	(173)
Costello Daly et al. 1994[b]	Kenya		3.3	Family planning	27/132 20.5	3,440/3,901 88.2	27/488 5.5	461/488 94.5	3,467/4,033 86.0	(4,033)
Herrmann et al. 1996[a]	Nicaragua		4.3	Antenatal clinic, family planning, general clinic	30/37 81.1	259/826 31.4	30/597 5.0	567/597 95.0	289/863 33.5	(863)
Mayaud et al. 1995	Tanzania, rural		8.4	Antenatal clinic	18/81 22.2	106/883 12.0	18/124 14.5	106/124 85.5	795/964 82.5	(964)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	3/31 9.7	229/260 88.1	3/34 8.8	31/34 91.2	232/291 79.7	(291)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	35/75 46.7	857/1,085 79.0	35/263 13.3	228/263 86.7	892/1,160 76.9	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**5.5**		**162/451 35.9**	**5,538/7,784 71.1**	**162/1,737 9.3**	**1,575/1,737 90.7**	**6,371/8,235 77.4**	**(8,235)**
Behets et al. 1995	Jamaica		33.7	With sexually transmitted disease	164/244 67.2	195/480 40.6	285/449 63.5	164/449 36.5	359/724 49.6	(724)

[a] Chlamydia only. [b] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A12 Risk factor: More than one partner in a specified period, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Acosta-Cazares et al. 1996[a]	Mexico, rural	Lifetime	7.3	General clinic	14/41 34.1	467/518 90.2	14/65 21.5	51/65 78.5	481/559 86.0	(559)
Bourgeois et al. 1996	Gabon	Not specified	13.5	Antenatal clinic	2/26 7.7	132/166 79.5	2/29 6.9	27/29 93.1	134/192 69.8	(192)
Braddick et al. 1990	Kenya	During pregnancy	15.7	Antenatal clinic	5/28 17.9	144/150 96.0	5/11 45.5	6/11 54.5	149/178 83.7	(178)
Costello Daly et al. 1994[b]	Kenya	Past year	3.3	Family planning	18/130 13.8	3,609/3,847 93.8	18/256 7.0	238/256 93.0	3,627/3,977 91.2	(3,977)
Kapiga et al. 1996	Tanzania	Last 3 months	8.2	Family planning	9/74 12.2	794/823 96.5	9/38 23.7	29/38 76.3	803/897 89.5	(897)
Mayaud et al. 1995	Tanzania, rural	Last year	8.4	Antenatal clinic	20/81 24.7	751/883 85.1	20/152 13.2	132/152 86.8	771/964 80.0	(964)
Thomas et al. 1994	Kenya	Past 3 months	0.8	Antenatal clinic	3/31 9.7	243/260 93.5	3/20 15.0	17/20 85.0	246/291 84.5	(291)
Thongkrajai 1997	Thailand, rural	Past year	4.7	General population	2/27 7.4	537/546 98.4	2/11 18.2	9/11 81.8	538/573 93.9	(573)
Vuylsteke et al. 1993b	Zaire	Last year	6.5	Antenatal clinic	37/75 49.3	889/1,085 81.9	35/231 15.2	196/231 84.8	924/1,160 79.7	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**5.8**		**110/513 21.4**	**7,566/8,278 91.4**	**108/813 13.3**	**705/813 86.7**	**7,673/8,791 87.3**	**(8,791)**
Vuylsteke et al. 1993b	Zaire	>3 clients/week	31.0	Female sex workers	300/379 79.2	221/843 26.2	300/922 32.5	622/922 67.5	521/1,222 42.6	(1,222)
Meta-analysis: Female sex workers			**31.0**		**300/379 79.2**	**221/843 26.2**	**300/922 32.5**	**622/922 67.5**	**521/1,222 42.6**	**(1,222)**

[a] Chlamydia only. [b] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A13 Risk factor: Partner symptomatic, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Kaufman et al. 1996[a]	China, rural		5.4	General population	5/90 5.5	1,434/1,554 92.3	5/125 4.0	120/125 96.0	1,439/1,644 87.5	(1,644)
Kaufman et al. 1996[b,c]	China, rural		0.4	General population	2/7 28.6	1,619/1,637 98.9	2/20 10.0	18/20 90.0	1,621/1,644 98.6	(1,644)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	2/31 6.5	256/260 98.5	2/6 33.3	4/6 66.7	258/291 88.7	(291)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	1/34 11.8	646/661 97.7	1/16 6.3	15/16 93.8	647/695 93.1	(695)
Meta-analysis: General, family planning, and antenatal clinic populations			**5.9**		**8/155 5.2**	**2,336/2,475 94.4**	**8/147 5.4**	**139/147 94.6**	**2,344/2,630 89.1**	**(2,630)**

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A14 Risk factor: Condom not used, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Bourgeois et al. 1996	Gabon		13.5	Antenatal clinic	6/26 23.1	133/166 80.1	6/39 15.4	33/39 84.6	139/192 72.4	(192)
Costello Daly et al. 1994[b]	Kenya		3.3	Family planning	129/132 97.7	70/3,901 1.8	129/3,960 3.3	3,831/3,960 96.7	199/4,033 4.9	(4,033)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	31/34 91.2	64/661 9.7	31/628 4.9	597/628 95.1	95/695 13.7	(695)
Thomas et al. 1994	Kenya		10.8	Antenatal clinic	3/30 10.0	247/260 95.0	3/16 18.8	13/16 81.3	250/291 85.9	(291)
Vuylsteke et al. 1993b	Zaire		6.5	Antenatal clinic	67/75 89.3	115/1,085 10.6	67/1,037 6.5	970/1,037 93.5	182/1,160 15.7	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**4.7**		**236/297 79.5**	**629/6,073 10.4**	**236/5,680 4.2**	**5,444/5,680 95.8**	**865/6,371 13.6**	**(6,371)**
Vuylsteke et al. 1993b	Zaire		31.0	Female sex workers	334/379 88.1	100/843 11.9	334/1,077 31.0	743/1,077 69.0	434/1,222 35.6	(1,222)

[a] Chlamydia only. [b] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A15 Risk factor: Used oral contraceptives, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Acosta-Cazares et al. 1996[a]	Mexico, rural		7.3	General clinic	10/41 24.4	433/518 83.6	10/95 10.5	85/95 89.5	443/559 79.2	(559)
Costello Daly et al. 1994[b]	Kenya		3.3	Family planning	42/132 31.8	2,788/2,878 96.9	42/1,155 3.6	1,113/1,155 96.4	2,830/4,033 70.2	(4,033)
Herrmann et al. 1996[a]	Nicaragua		4.3	Antenatal clinic, family planning, general clinic	11/37 29.7	736/826 89.1	11/101 10.9	90/101 89.1	747/863 86.6	(863)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	3/34 8.8	627/661 94.9	3/37 8.1	34/37 91.9	630/695 90.6	(695)
Meta-analysis: General, family planning, and antenatal clinic populations			**4.0**		**66/244 27.1**	**4,584/4,883 93.9**	**66/1,388 4.8**	**1,322/1,388 95.3**	**4,650/6,150 75.6**	**(6,150)**

[a] Chlamydia only. [b] Gonorrhea only.

Screening criteria for signs, symptoms, simple tests, and risk factors to identify case status for chlamydia and/or gonorrhea

Table A16 Risk factor: Used IUD, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Acosta-Cazares et al. 1996[a]	Mexico, rural		7.3	General clinic	22/41 53.7	289/518 55.8	22/251 8.8	229/251 91.2	311/559 55.6	(559)
Costello Daly et al. 1994[b]	Kenya		3.3	Family planning	16/132 12.1	3,496/3,901 89.6	16/421 3.8	405/421 96.2	3,512/4,033 87.1	(4,033)
Herrmann et al. 1996[a]	Nicaragua		4.3	Antenatal clinic, family planning, general clinic	2/37 5.4	717/826 86.8	2/111 1.8	109/111 98.2	719/863 83.3	(863)
Kaufman et al. 1996	China, rural		5.9	General population	5/97 5.2	993/1,547 64.2	5/566 0.9	561/566 99.1	998/1,644 60.7	(1,644)
Ronsmans et al. 1996[a]	Turkey		4.9	General population	10/34 29.4	477/661 72.2	10/194 5.2	184/194 94.8	487/695 70.1	(695)
Meta-analysis: General, family planning, and antenatal clinic populations			**4.4**		**55/341 16.1**	**5,972/7,453 80.1**	**55/1,543 3.6**	**1,488/1,543 96.4**	**6,027/7,794 77.3**	**(7,794)**

[a] Chlamydia only. [b] Gonorrhea only.

Tables A17–A20 Nonlaboratory tools used to identify case status

Table A17 Simple management tools for case finding in routine clinic and general populations and among female sex workers, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases percent	Test efficiency Cases Percent	(n)
Case finding										
Routine clinic and general populations										
Kapiga et al. 1996	Tanzania	Vaginal discharge or dysuria	8.2	Family planning	22/74 29.7	707/823 85.9	22/138 15.9	116/138 84.1	729/897 81.3	(897)
Mayaud et al. 1995	Tanzania, rural	S1 (Reported vaginal discharge and/or genital itching)	8.4	Antenatal clinic	35/81 43.2	513/883 58.1	35/405 8.6	370/405 91.4	548/964 56.8	(964)
Mayaud et al. 1995[b]	Tanzania, rural	S2 (Reported vaginal discharge, genital itching, lower abdominal pain, dysuria, or dyspareunia)	8.4	Antenatal clinic	58/81 71.6	305/883 34.5	58/636 9.1	578/636 90.9	363/964 37.7	(964)
Ronsmans et al. 1996[a]	Turkey	Reported profuse discharge	4.9	General population	8/34 23.5	580/652 89.0	7/79 8.9	72/79 91.1	588/686 85.7	(686)
Vuylsteke et al. 1993b	Zaire	1st level, hierarchical (Algorithm for vaginal discharge and lower abdominal pain in settings where speculum exam is not possible)	6.5	Antenatal clinic	36/75 48.0	816/1,085 75.2	36/305 11.8	269/305 88.2	852/1,160 73.4	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**7.1**		**101/264 38.3**	**2,616/3,443 76.0**	**100/927 10.8**	**827/927 89.2**	**2,717/3,707 73.3**	**(3,707)**
Female sex workers										
Vuylsteke et al. 1993b	Zaire	1st level, hierarchical (Algorithm for vaginal discharge and lower abdominal pain in settings where speculum exam is not possible)	31.0	Female sex workers	208/379 54.9	440/843 52.2	208/611 34.0	403/611 66.0	648/1,222 53.0	(1,222)

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility.

Table A18 Simple management tools using speculum exams for case finding in routine clinic and general populations and among female sex workers, and for case management among symptomatic women, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Case finding										
Routine clinic and general populations										
Acosta-Cazares et al. 1996[a]	Mexico, rural	Any 4 GUSS	7.3	General clinic	13/41 31.7	516/518 99.6	13/15 86.7	2/15 13.3	529/559 94.6	(559)
Acosta-Cazares et al. 1996[a,b]	Mexico, rural	Any 1 GUSS	7.3	General clinic	41/41 100	130/518 25.1	41/429 9.6	388/429 90.4	171/559 30.6	(559)
Acosta-Cazares et al. 1996[a,b]	Mexico, rural	Any 2 GUSS	7.3	General clinic	36/41 87.8	323/518 62.4	36/231 15.6	195/231 84.4	359/559 64.2	(559)
Acosta-Cazares et al. 1996 [a,b]	Mexico, rural	Any 3 GUSS	7.3	General clinic	24/41 58.5	461/518 89.0	24/81 29.6	57/81 70.4	485/559 86.8	(559)
Costello Daly et al. 1994[c]	Kenya	Vaginal discharge, cervicitis	3.3	Family planning	26/132 19.7	3,488/3,833 91.0	26/371 7.0	345/371 93.0	3,514/3,965 88.6	(3,965)
Kapiga et al. 1996	Tanzania	Mucopus or friability	8.2	Family planning	15/74 20.3	742/843 88.0	15/96 15.6	81/96 84.4	757/897 84.4	(897)
Kaufman et al. 1996[a]	China, rural	All 3 major signs (Yellow, green, or bloody discharge, thick discharge, and abnormal cervical exterior)	5.5	General population	35/90 38.9	1,006/1,554 64.7	35/583 6.0	548/583 94.0	1,041/1,644 63.3	(1,644)
Kaufman et al. 1996[b,c]	China, rural	All 3 major signs	0.4	General population	4/7 57.1	974/1,637 59.5	4/667 0.6	663/667 99.4	978/1,644 59.5	(1,644)
Mayaud et al. 1995	Tanzania, rural	S1 + exam (If reported symptoms [S1], then examined, and treated only if abnormal vaginal discharge is seen)	8.4	Antenatal clinic	22/81 27.2	727/883 82.3	22/178 12.4	156/178 87.6	749/964 77.7	(964)
Ronsmans et al. 1996[a]	Turkey	Reported profuse discharge and cervical ectopy	5.0	General population	1/34 2.9	642/652 98.5	1/11 9.1	10/11 90.9	643/686 93.7	(686)
Vuylsteke et al. 1993b	Zaire	Other hierarchical (algorithm for vaginal discharge and lower abdominal pain in settings where speculum exam is possible)	6.5	Antenatal clinic	22/75 29.3	926/1,085 85.3	22/181 12.2	159/181 87.8	948/1,160 81.7	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**5.3**		**134/527 25.4**	**8,047/9,368 85.9**	**134/1,435 9.3**	**1,301/1,435 90.7**	**8,181/9,875 82.8**	**(9,875)**

Table A18 (continued)

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Female sex workers										
Germain et al. 1997	Benin	Algorithm (Speculum exam and vaginal wet mount, mucopus, yellow swab, vaginal leucocytes >10/field)	39.8	Female sex workers	84/145 57.9	134/219 61.2	84/169 49.7	85/169 50.3	218/364 59.9	(364)
Meta-analysis: Female sex workers			**39.8**		**84/145 57.9**	**134/219 61.2**	**84/169 49.7**	**85/169 50.3**	**218/364 59.9**	**(364)**
Case management										
Behets et al. 1995	Jamaica	Algorithm A (Examine cervix; if detect cervical mucopus, treat for CT/NG)	31.9	With sexually transmitted disease	59/81 72.8	96/173 55.5	59/136 43.4	77/136 56.6	155/254 61.0	(254)
Germain et al. 1997	Benin	Algorithm (Speculum exam and vaginal wet mount, mucopus, yellow swab, vaginal leucocytes >10/field but used among symptomatic females only [vaginitis])	46.5	Female sex workers (sympto-matic)	27/40 67.5	18/46 39.1	27/55 49.1	28/55 50.9	45/86 52.3	(86)
Meta-analysis			**35.6**		**86/121 71.1**	**114/219 52.1**	**86/191 45.0**	**105/191 55.0**	**200/340 58.8**	**(340)**

GUSS = genitourinary signs and symptoms: urinary symptoms, cervical inflammation, friability, and mucopurulent discharge.

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only.

Table A19 Management strategies that include risk factors, for case finding in routine clinic and general populations, and for case management among symptomatic women, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Case finding										
Routine clinics and general populations										
Bourgeois et al. 1996	Gabon	Algorithm: Reported symptoms + clinical exam + speculum; age ≤25; marital status	13.5	Antenatal clinic	14/26 53.8	100/166 60.2	14/80 17.5	66/80 82.5	114/192 59.4	(192)
Bourgeois et al. 1996[b]	Gabon	Algorithm: Age ≤25, marital status, reported symptoms + clinical exam + speculum of PMN	13.5	Antenatal clinic	15/26 57.7	85/166 51.2	15/96 15.6	81/96 84.4	100/192 52.1	(192)
Bourgeois et al. 1996[b]	Gabon	Algorithm: Reported vaginal discharge, and at least 2 of: age ≤25; marital status; lower back pain; lower abdominal pain	13.5	Antenatal clinic	18/26 69.2	85/166 51.2	18/99 18.2	81/99 81.8	103/192 53.6	(192)
Braddick et al. 1990	Kenya	Clinical cervicitis and/or >1 partner during period of pregnancy	15.7	Antenatal clinic	19/28 67.9	140/150 93.3	19/29 65.5	10/29 34.5	159/178 89.3	(178)
Braddick et al. 1990[b]	Kenya	Clinical cervicitis and >1 partner during period of pregnancy	15.7	Antenatal clinic	3/28 10.7	129/150 86.0	3/24 12.5	21/24 87.5	132/178 74.2	(178)
Costello Daly et al. 1994 [b,c]	Kenya	Unmarried	3.3	Family planning	26/132 19.7	3,373/3,833 88.0	26/486 5.3	460/486 94.7	3,399/3,965 85.7	(3,965)
Costello Daly et al. 1994[b,c]	Kenya	>1 partner in past year	3.3	Family planning	18/132 13.6	3,603/3,833 94.0	18/248 7.3	230/248 92.7	3,621/3,833 94.5	(3,965)
Costello Daly et al. 1994[b,c]	Kenya	Unmarried and/or >1 partner in past year and/or vaginal discharge/ cervicitis	3.3	Family planning	50/132 37.9	2,913/3,833 76.0	50/970 5.2	920/970 94.8	2,963/3,965 74.7	(3,965)
Costello Daly et al. 1994[c]	Kenya	Unmarried and >1 partner in past year and vaginal discharge/cervicitis	3.3	Family planning	3/132 2.3	3,819/3,833 99.6	3/17 17.6	14/17 82.4	3,822/3,965 96.4	(3,965)
Kapiga et al. 1996	Tanzania	Tanzanian flowchart[d]	8.2	Family planning	10/74 13.5	757/823 92.0	10/76 13.2	66/76 86.8	767/897 85.5	(897)
Meda et al. 1997	Burkina Faso	Length of relationship w/ regular partner <3 years, and urine leukocyte esterase test positive	30/365 4.7	Antenatal clinic	24/30 80.0	311/615 50.6	24/328 7.3	304/328 92.7	335/645 51.9	(645)
Ronsmans et al. 1996[a]	Turkey	Reported discharge in husband and age <25	4.9	General population	0/34 0	653/656 99.5	0/3 0	3/3 100.0	653/690 94.6	(690)

Table A19 (continued)

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Ronsmans et al. 1996[a,b]	Turkey	WHO w/o exam[e]	4.9	General population	3/34 8.8	631/656 96.2	3/28 10.7	25/28 89.3	634/690 91.9	(690)
Ronsmans et al. 1996[a,b]	Turkey	WHO w/exam[f]	4.9	General population	16/34 47.1	364/649 56.1	16/301 5.3	285/301 94.7	380/690 55.1	(690)
Ronsmans et al. 1996[a,b]	Turkey	Reported discharge in husband	4.9	General population	4/34 11.8	621/656 94.7	4/29 13.8	25/29 86.2	625/690 90.6	(690)
Meta-analysis: General, family planning, and antenatal clinic populations			**4.9**		**70/324 21.6**	**5,780/6,243 92.6**	**70/533 13.1**	**463/533 86.9**	**5,850/6,567 89.1**	**(6,567)**
Case management										
Behets et al. 1995	Jamaica	Adjusted Algorithm A: Examine cervix; if detect cervical mucopus, treat for chlamydia/ gonorrhea (but only applied to women who have not been referred by a symptomatic partner)	31.9	With sexually transmitted disease	63/81 77.8	87/173 50.3	63/149 42.3	86/149 57.7	150/254 59.1	(254)
Coetzee and Mathews 1998	South Africa	Same as below, but age cutoff <25 years	44/161 27.3	With sexually transmitted disease	35/44 79.5	58/117 49.6	35/94 37.2	59/94 62.8	93/161 57.8	(161)
Coetzee and Mathews 1998[b]	South Africa	Standard algorithm: Women, < 45 years of age, sexually active, not pregnant, and pre-menopausal, reporting vaginal discharge and/or lower abdominal pain	44/161 27.3	With sexually transmitted disease	42/44 95.5	20/117 17.1	42/140 30.0	98/140 70.0	62/161 38.5	(161)
Coetzee and Mathews 1998[b]	South Africa	Same as above, but age cutoff <30 years	44/161 27.3	With sexually transmitted disease	40/44 90.9	34/117 29.1	40/123 32.5	83/123 67.5	74/161 46.0	(161)
Meta-analysis			**30.1**		**98/125 78.4**	**145/290 50.0**	**98/243 40.3**	**145/243 59.7**	**243/415 58.6**	**(415)**

PMN = Polymorphonuclear leukocytes

[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility. [c] Gonorrhea only. [d] Women who complain of abdominal pain are diagnosed with cervicitis if they have a temperature >38º C or pain on cervical motion. Women who complain of vaginal discharge are diagnosed with cervicitis and vaginitis if they are at high risk of STDs (that is, partner is symptomatic or at least two of: age <21; single; >1 partner; new partner in last three months). When the risk assessment is negative, these women are diagnosed with vaginitis. [e] In settings where a vaginal exam is not possible, women are diagnosed with cervicitis (due to chlamydia/gonorrhea) if they complain of vaginal discharge and are at high risk of STDs (that is, partner symptomatic, or any two of: age<21 years; single; >1 partner; new partner in last three months). [f] In settings where a clinical exam is possible (including vaginal and abdominal exam), women are diagnosed with cervicitis (due to chlamydia/gonorrhea) if they complain of vaginal discharge and are at high risk of STDs (see note above) or if they complain of vaginal discharge and a speculum exam reveals mucopurulent discharge from the cervix. Women in this setting who complain of lower abdominal pain are diagnosed with pelvic inflammatory disease (PID) (due to chlamydia/gonorrhea) if they have a temperature >38ºC, pain on cervical motion, or vaginal discharge.

Table A20 Management strategies including risk scoring for case finding in routine clinic and general populations and among female sex workers and for case management among symptomatic women, by study, according to selected measures

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Case finding										
Routine clinics and general populations										
Bourgeois et al. 1996	Gabon	Algorithm 1 (score ≥3): age <25, vaginal discharge symptom, low back pain, yellow-green discharge clinical exam, malodorous discharge clinical exam; any 1 of 3: cervical discharge, cervical ulcer, cervical friability	13.5	Antenatal clinic	19/26 73.1	96/166 57.8	19/89 21.3	70/89 78.7	115/192 59.9	(192)
Bourgeois et al. 1996[b]	Gabon	Algorithm 2 (score ≥3): = Algorithm 1 w/o vaginal discharge symptom + not married	13.5	Antenatal clinic	19/26 73.1	90/166 54.2	19/95 20.0	76/95 80.0	109/192 56.8	(192)
Bourgeois et al. 1996[b]	Gabon	Algorithm 3 (score ≥3): = Algorithm 2 w/o malodorous discharge + lower abdominal pain	13.5	Antenatal clinic	21/26 80.8	75/166 45.2	21/112 18.7	91/112 81.3	96/192 50.0	(192)
Bourgeois et al. 1996[b]	Gabon	Algorithm 4 (score ≥3): = Algorithm 1 w/o malodorous discharge, + lower abdominal pain	13.5	Antenatal clinic	20/26 76.9	85/166 51.2	20/101 19.8	81/101 80.2	105/192 54.7	(192)
Kapiga et al. 1996	Tanzania	Score ≥ 1, examine and treat if mucopus or friability (see above)	8.2	Family planning	6/74 8.1	802/823 97.4	6/27 22.2	21/27 77.8	808/897 90.1	(897)
Kapiga et al. 1996[b]	Tanzania	Score ≥1 Variables: New partner in last 3 months (2); >1 partner (1); cohabiting (1); single (2); <20 yrs (1); husband <25 yrs (2); symptoms of vaginal discharge (2); dysuria (2). Score = sum of points for each variable present.	8.2	Family planning	54/74 73.0	411/823 49.9	56/466 12.0	412/466 88.4	465/897 51.8	(897)
Kapiga et al. 1996[b]	Tanzania	Score ≥ 2 (see above)	8.2	Family planning	43/74 58.1	561/823 68.2	43/305 14.1	262/305 85.9	604/897 67.3	(897)
Kapiga et al. 1996[b]	Tanzania	Score 1–3; examine and treat if mucopus or friability; or score ≥4 (see above)	8.2	Family planning	28/74 37.8	720/823 87.5	28/131 21.4	103/131 78.6	748/897 83.4	(897)
Mayaud et al. 1995	Tanzania, rural	R1+exam Women with a risk score (R1 simplified) ≥ the cutoff value are treated only if abnormal vaginal discharge is seen.	8.4	Antenatal clinic	25/81 30.9	777/883 88.0	25/131 19.1	106/131 80.9	802/964 83.2	(964)

Table A20 (continued)

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Mayaud et al. 1995[b]	Tanzania, rural	R1 Optimal (R1- Score based on sociodemo-graphic factors ≥ the cutoff value. Optimal score obtained from logistic regression coefficients [x10] of factors still significant upon multivariate analysis)	8.4	Antenatal clinic	43/81 53.1	713/883 80.7	43/213 20.2	170/213 79.8	756/964 78.4	(964)
Mayaud et al. 1995[b]	Tanzania, rural	R1 Simplified (R1- Same as above. Simplified, each factor present given score of 1)	8.4	Antenatal clinic	37/81 45.7	745/883 84.4	37/175 21.1	138/175 78.9	782/964 81.1	(964)
Mayaud et al. 1995[b]	Tanzania, rural	R2 Optimal (R2- Score based on sociodemo-graphic factors and reported symptoms ≥ the cutoff value. Optimal, see above)	8.4	Antenatal clinic	44/81 54.3	690/883 78.1	44/237 18.6	193/237 81.4	734/964 76.1	(964)
Mayaud et al. 1995[b]	Tanzania, rural	R2 Simplified (see above)	8.4	Antenatal clinic	56/81 69.1	476/883 53.9	56/463 12.1	407/463 87.9	532/964 55.2	(964)
Mayaud et al. 1995[b]	Tanzania, rural	S1+R1 Women reporting symptoms (S1) are questioned and treated only if their risk score (R1simplified) ≥ the cutoff value.	8.4	Antenatal clinic	29/81 35.8	736/883 83.4	29/176 16.5	147/176 83.5	765/964 79.4	(964)
Thomas et al. 1994	Kenya	Tanzania R1 Simplified (see Mayaud R1 simplified)	31/286 10.8	Antenatal clinic	4/31 12.9	233/255 91.4	4/36 11.1	32/36 88.9	237/286 82.9	(286)
Thomas et al. 1994[b]	Kenya	Zaire risk score (see Vuylsteke score-driven algorithm)	27/214 12.6	Antenatal clinic	5/27 18.5	141/187 75.4	5/51 9.8	46/51 90.2	146/214 68.2	(214)
Thongkrajai 1996[a]	Thailand	Score driven Variables: Husbands' frequency of working away from home; husband and wife living together during last three months and lower abdominal pain. Scores of 11,10, and 8 assigned, respectively. Scores summed, value >8 = decision to treat.	3.9	MCH/FP	19/25 76.0	288/616 46.8	19/347 5.5	328/347 94.5	307/641 47.9	(641)

Table A20 (continued)

Study (authors/date)	Country	Specification	Prevalence (percent)	Population	Sensitivity Cases Percent	Specificity Cases Percent	Positive predictive value Cases Percent	False-positive rate Cases Percent	Test efficiency Cases Percent	(n)
Vuylsteke et al. 1993b	Zaire	Score driven Variables: single (5); >1 partner in last year (10); <25 years (14); 25–34 years (11); reported vaginal discharge (1); lower abdominal pain (3); LED (10, 12, 15). Total score of >28 considered infected.	6.5	Antenatal clinic	54/75 72.0	797/1,085 73.5	54/342 15.8	288/342 84.2	851/1,160 73.4	(1,160)
Meta-analysis: General, family planning, and antenatal clinic populations			**7.5**		**127/312 40.7**	**2,993/3,828 78.2**	**127/972 13.1**	**845/972 86.9**	**3,120/4,140 75.4**	**(4,140)**
Female sex workers										
Vuylsteke et al. 1993b	Zaire	Score driven Variables: single (5); >1 partner in last year (10); <25 years (14); 25–34 years (11); reported vaginal discharge (1); lower abdominal pain (3); LED (10, 12, 15). Total score of >28 considered infected.	31.0	Female sex workers	269/379 71.0	470/843 55.8	269/642 41.9	373/642 58.1	739/1,222 60.5	(1,222)
Meta-analysis: Female sex workers			**31.0**		**269/379 71.0**	**470/843 55.8**	**269/642 41.9**	**373/642 58.1**	**739/1,222 60.5**	**(1,222)**
Case management										
Behets et al. 1995	Jamaica	Algorithm B Risk-assessment variables: partner has urethral discharge (2); <21 years (1); new partner in last 3 months (1); >1 partner in last 3 months (1); not living with steady partner (1). If score is >2, treat for chlamydia/gonorrhea. If score <2, examine with speculum for mucopus [algorithm A].		With sexually transmitted disease	71/84 84.5	62/155 40.0	71/164 43.3	93/164 56.7	133/239 55/6	(239)

LED = Leukocyte esterase dipstick.
[a] Chlamydia only. [b] Not included in meta-analysis so as to include single study only once. Specification with best test efficiency or CT instead of GC only included in meta-analysis to produce highest screening utility.