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Global control of sexually transmitted infections*

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Sexually transmitted infections other than HIV are important global health issues. They have, however, been neglected as a public-health priority and control efforts continue to fail. Sexually transmitted infections, by their nature, affect individuals, who are part of partnerships and larger sexual networks, and in turn populations. We propose a framework of individual, partnership, and population levels for examining the effects of sexually transmitted infections and interventions to control them. At the individual level we have a range of effective diagnostic tests, treatments, and vaccines. These options are unavailable or inaccessible in many resource-poor settings, where syndromic management remains the core intervention for individual case management. At the partnership level, partner notification and antenatal syphilis screening have the potential to prevent infection and re-infection. Interventions delivered to whole populations, or groups in whom the risks of infection and onward transmission are very high, have the greatest potential effect. Improvements to the infrastructure of treatment services can reduce the incidence of syphilis and gonorrhoea or urethritis. Strong evidence for the effectiveness of most other interventions on population-level outcomes is, however, scarce. Effective action requires a multifaceted approach including better basic epidemiological and surveillance data, high quality evidence about effectiveness of individual interventions and programmes, better methods to get effective interventions onto the policy agenda, and better advocacy and more commitment to get them implemented properly. We must not allow stigma, prejudice, and moral opposition to obstruct the goals of infectious disease control.

Introduction

" … nice people don't talk about syphilis, nice people don't have syphilis, and nice people shouldn't do anything about those who do have syphilis."[1]

This 1937 analysis of the barriers to syphilis control in the USA by Thomas Parran, a former Surgeon General, helps us to understand why the control of this and other sexually transmitted infections continues to fail worldwide. The responses of governments and societies to sexually transmitted infections often seem to be affected more by moral judgments and social attitudes towards sexual behaviour than the degree of death, disease, and distress caused by the medical conditions. Cultural meanings and prejudices become attached to infected people, who become stigmatised as being wicked, dirty, and not deserving of care,[2] even though sexually transmitted infections are often acquired through consensual, pleasurable, and legal sexual intercourse.

For HIV infection, governments have been convinced to invest in HIV programmes mainly by macroeconomic arguments about the negative effect of poor health on economic growth.[3] Combating HIV infection is now one of the Millennium Development Goals (MDGs) and international commitment is guaranteed. Even so, some world leaders would not allow a UN declaration to openly specify that men who have sex with men, sex workers, and injecting drug users needed specific interventions.[4] All other sexually transmitted infections, which were high on the international policy agenda in the 1990s,[5] now receive little attention, and are not named in the MDGs. Although diagnosis and treatment of sexually transmitted infections are now officially recognised as a low cost, neglected intervention by the Disease Control Priorities Project, they are considered only as a means of reducing the risk of HIV transmission.[6]

Sexual and reproductive tract infections other than HIV are important global health priorities in

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their own right,[7] but their impact is often unrecognised. Human papillomaviruses (HPV) cause almost all cervical cancers but the 3·3 million disability adjusted life years (DALYs) that they cause are included in estimates of mortality and morbidity due to cancer rather than sexually transmitted infection.[8] Syphilis, responsible for 4·2 million DALYs, can be fatal, and infection in pregnant women causes stillbirth, prematurity, and congenital syphilis. Effective screening programmes could prevent up to 492 000 stillbirths and perinatal deaths every year,[9] with a cost per DALY that is lower than prevention of a case of perinatal HIV infection.[9,10] Chlamydia and gonorrhoea (7 million DALYs) cause tubal infertility and, potentially fatal, ectopic pregnancy. Vaginal discharge prompts women to seek frequent care, which is expensive, often ineffective, and sometimes harmful.[11] Candida and bacterial vaginosis, which are the most common reproductive tract infections in women, and cause distressing symptoms that are frequently misdiagnosed as sexually transmitted infections, are not included in the burden of disease calculations.[12] Women are disproportionately physically affected by all these infections. Transmission rates from men to women are higher than from women to men, in part because of the exposure of columnar epithelium.[13] Signs of infection in women, however, can remain hidden until it is too late to reverse the damage. Furthermore, women are more vulnerable to infection because of gender-based power inequalities.[14] Women who manage to overcome these barriers and get diagnosed with a sexually transmitted infection might then be blamed for being the reservoir of infection and face judgment, stigma, and possibly violence from their partners.[13]

We need to renew our commitment to controlling all sexually transmitted infections. Parran,[1] in his call for dispassionate public-health action to replace "moral prophylaxis" in the control of syphilis, proposed a thoroughly modern agenda. This action included location, reporting, and treatment of all cases and contacts, ensuring that there were enough money, drugs, and doctors to provide the service; education of the public, and demanding that public-health agencies and private physicians used "scientific methods".[1] In today's words, we should take an evidence-based public-health approach to treatment and prevention. This approach should also include sustainable implementation of preventive policies and effective integration of sexual and reproductive health services, in addition to the traditional focus on case management of the individual.[15]

We focus on strategies for the control of sexually transmitted infections other than HIV. There is, however, an important biological interaction between HIV and other sexually transmitted infections that affects control strategies.[16] Sexually transmitted infections, especially those that cause genital ulceration, increase the risk of acquisition and transmittal of HIV infection, and the treatment of sexually transmitted infections reduces the shedding of HIV in genital secretions and plasma.[17,18] Therefore, we also discuss interventions in which control of sexually transmitted infection is used to prevent HIV infection. We present our key messages in panel 1.

Framework for control of sexually transmitted infections

Sexually transmitted infections exert their effects at different levels—individual-based, sexual and maternal-child partnership, and also larger communities and populations (figure 1). The connections between these groups are intrinsic to the nature of infections transmitted from person to person by sexual intercourse and therefore to their control. Mixing between individuals is a characteristic of partnerships, which form within sexual networks. Sexual networks are structural and temporal representations of the way in which individuals (nodes) are linked through sexual relationships, and provide pathways through which infection can be transmitted.[19] Partnership and network formation, and the chance of acquiring and transmitting an infection sexually are not random; they are determined by individual factors, cultural values, geography, demography, economics, health service, and political and legal structures.[20] As a result, there are individuals whose sexual behaviour patterns, and social and health-seeking behaviours within networks, contribute disproportionately to the transmission of infection. These core groups can sustain an epidemic of a sexually transmitted infection and, through bridging populations, can continue to drive sporadic transmission in the general population (figure 2).[21]

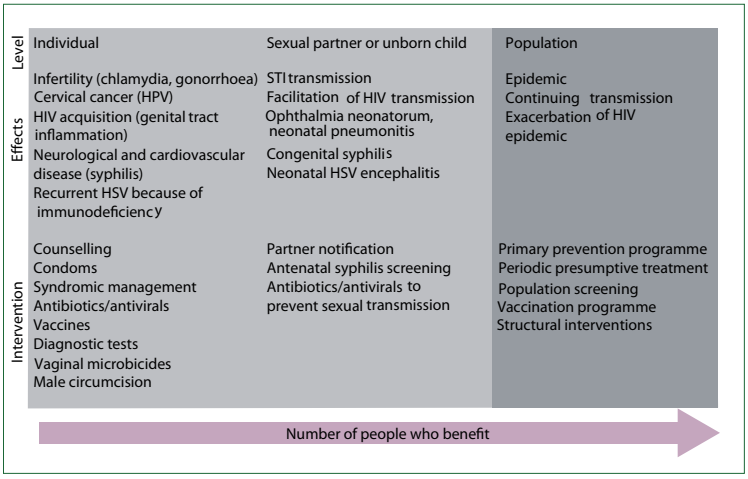

Figure 1: Levels at which sexually transmitted infections have their effects
HPV=human papillomavirus. HSV=herpes simplex virus. STI=sexually transmitted infection.

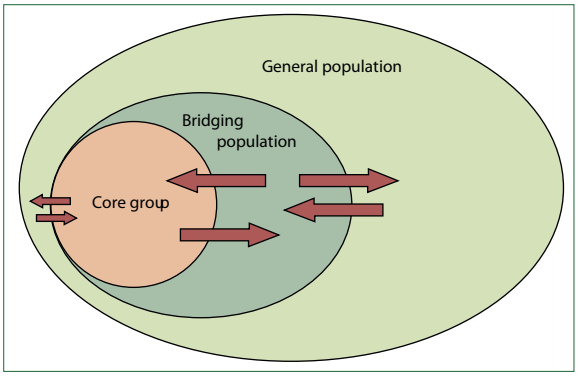

Figure 2: Sexually transmitted infection transmission dynamics at the population level[15]
Arrows show direction of sexual contact between core groups, bridging populations, and general population

Panel 1: Key messages

- Sexually transmitted infections, and other reproductive tract infections, cause substantial disease, death, and misery but not, apparently, enough for societies to overcome the stigma and prejudice that prevent investment in effective control measures.
- Sexually transmitted infections and interventions to control them have effects on individuals, partnerships, and populations. Individual-based interventions should reduce morbidity and improve management of the individual. Partnership-based interventions should show that they benefit both members of the couple. Population-based interventions should be able to show that they reduce transmission in the study population.
- For individuals there are effective diagnostic tests, antibiotics for bacterial and protozoal sexually transmitted infections, suppressive antivirals, and vaccines against hepatitis B and human papillomavirus infections, but many of these options are not available in resource-poor settings.
- Syndromic management is at the core of the WHO strategy for the management of individuals with sexually transmitted infections in resource-poor settings. Although it works for urethral discharge in men and for genital ulcer disease, alternative strategies are needed to control cervical infections (gonorrhoea and chlamydia) in many settings because the syndrome of vaginal discharge is a poor proxy for endocervical infection.
- Antenatal syphilis screening is an intervention for the mother-child partnership that could prevent half a million fetal deaths per year. This screening could be done by providing rapid on-site syphilis testing and treatment as part of a package of services to strengthen antenatal services, including health promotion, training, partner management, and logistical support to the health system.
- There is a gap between evidence and practice in the implementation of screening programmes in populations. Randomised trials show that proactive approaches that systematically invite a population to be screened can reduce the incidence of pelvic inflammatory disease and chlamydia prevalence. The opportunistic approach adopted by national chlamydia control activities in Sweden, the USA, and England has not been assessed in randomised trials.
- Population-based programmes to deliver new HPV vaccines could prevent up to 70% of all cervical cancers worldwide. The initial target population is girls before, or around the time of, sexual debut, which presents a unique opportunity to promote and strengthen sexual and reproductive health strategies for adolescents and young women, who are traditionally difficult to reach.
- Integration of interventions at all levels to control sexually transmitted and reproductive tract infections within a broader range of sexual and reproductive health services has the potential to reach a much wider audience than provision of only specialist treatment services. This approach should be rigorously assessed, and should not be at the expense of developing interventions that reach men.
- Lobbying and obtaining funding to control sexually transmitted infections needs improved information about which interventions are effective for which groups and at what cost. Improvements are needed in three areas: increased surveillance of prevalence, cause, and antimicrobial resistance patterns; improved data about the natural history of sexually transmitted infections; and improved mathematical modelling studies that incorporate the dynamic effects of infections transmitted in sexual networks.
- The selection and implementation of strategies and policies is still fraught with problems, especially when these are overtly influenced by external determinants. Donors and national governments need to be persuaded that strategies to control sexually transmitted infections should not be tied solely to HIV/AIDS prevention programmes, and that investing in high quality, effective, and scaled up interventions will bring independent benefits to improved sexual and reproductive health.

The control measures needed are dependent on the sexually transmitted infection and its epidemic phase. The spread of infections within a particular population is dependent not only on people and their networks, but also on the virulence of the organism, and the duration of the infection. Highly transmissible and symptomatic infections—e.g., gonorrhoea in men—will tend to get treated quickly, and transmission can be sustained only in people with a high probability of encountering another infected person. Infections that are easily transmitted but cause few or no symptoms—e.g., chlamydia—can spread more generally through a population, although infection rates will still be higher in people with the greatest numbers of unprotected sexual contacts.[22] Time is also an important factor: newly emerging infections (e.g., syphilis in Europe in the 16th century) spread rapidly until they reach a hyperendemic equilibrium in the population. Infection rates will fall if sexual risk-taking behaviour or the virulence of the organism decreases, or the duration of infection is reduced. The infection then reaches a new lower equilibrium, with very low rates in the general population but continued hyperendemic transmission in core groups.[21] The distribution of gonorrhoea in many developed countries has followed this pattern.[22]

Interventions

Distinguishing between the individual and population-level effects of interventions to control sexually transmitted infections is important because the population is more than an aggregate of individuals, and the organisation of networks within the population affects the impact of interventions.[23,24] We propose that an intermediate level of intervention that recognises the importance of mother-child or sexual partnerships, and hence networks, should also be acknowledged. At the individual level, for example, effective antibiotics improve symptomatic case management but do not prevent re-infection in the index case unless partner notification has been done and the partner (and their partners) also benefits from the treatment. In partnerships, an intervention such as antenatal syphilis screening benefits the individual mother and her baby, but an effect at the population level is unlikely because screening this group only does not reduce general transmission. In populations, vaccination of all teenage girls against HPV might stop them developing cervical cancer, acquiring virus from, or transmitting it to, a new sexual partner, and ultimately reduce transmission of carcinogenic virus strains in the population. Beyond the population level, there are structural, legal, and policy interventions, such as laws to prevent discrimination, programmes to reduce sex-based inequalities, and policies to improve education or reduce income inequality.[25,26] These interventions are discussed by Wellings and colleagues.[27]

Population approaches have the potential to reach more people than one-to-one interventions (figure 1).[21,26] The paradigm, developed for non-communicable diseases, of reducing risk in whole populations

rather than offering interventions only to individuals at high risk is well recognised. However, for sexually transmitted infections, interactions between individuals with differing risk profiles can alter this balance.[23] Some interventions can have a greater effect on transmission if effectively delivered to a core group rather than to the general population (figure 2).[28] The most effective control measures will differ for every infection according to its transmission dynamics and stage of infection, but might be a combination of population-based interventions for the general public and targeted interventions for those at high risk. Targeted interventions can be organised to be delivered to the community or subpopulations.

Measurement of effectiveness

The primary measure of effectiveness for any intervention is clearly dependent on the level at which it is meant to act. For individuals, relevant outcomes are reduced morbidity, mortality, or complications. At the level of the partner, an intervention has to show that it benefits both members of the pair. Interventions aimed at controlling sexually transmitted infections in the population should show that they reduce transmission by reducing the incidence and prevalence of infection in the population at risk.

Figure 3 shows the range of sexually transmitted infections for which individual, partner, and population-based interventions are, or might soon be, available. It also shows those interventions for which there is the best evidence of effectiveness in prevention of the primary outcome, which is either morbidity or transmission. Best evidence of effectiveness means that effectiveness has been shown in high quality systematic reviews or large, well conducted individual randomised controlled trials, but also allows for convincing evidence from non-randomised assessments of interventions that have substantially reduced mortality[39]—e.g., antenatal screening for syphilis. We assigned quality of evidence mainly on the basis of the findings of existing systematic reviews[24,29–31,35,36,38,40,41] (see Search strategy and selection criteria).

A wide range of technical interventions that target individual or partnerships has been assessed (figure 3). Consistent, high quality evidence that these interventions contribute to reducing transmission of infection as part of population level programmes is, however, scarce.

Interventions for individuals

Condoms, both male and female, are widely promoted as an essential component of control programmes for sexually transmitted infections.[42] Consistent correct use without breakage or slippage should protect an uninfected person from acquiring an infection (primary prevention) and an infected person from transmitting infections (secondary prevention) if the site of infection is covered by the condom. In prospective studies, consistent condom use has reduced, but not eliminated, acquisition of gonorrhoea, chlamydia, genital herpes, and syphilis in men and women, and HPV and possibly trichomonal infections in women.[29,43] The reasons for condom failure are mainly human rather than mechanical. The effects of interventions to encourage condom use and other changes in sexual behaviour as primary prevention of sexually transmitted infections in individuals, partnerships, and populations are discussed by Wellings and colleagues.[27]

Despite the benefits of population approaches, the biomedical model prevails in the organisation and delivery of treatment. This model encourages the search for single solutions—magic bullets—to be used by individual physicians for individual patients.[15,44] In developed countries, diagnosis and management of individuals with sexually transmitted infections can be highly efficacious. There are accurate diagnostic tests, effective single-dose antibiotics for treatment of bacterial and protozoal infections, and suppressive antiviral therapies that reduce recurrences of genital herpes simplex virus (HSV) infections and progression of HIV and hepatitis B virus infections in the individual (figure 3).[31] In resource-poor settings, many of these effective technologies are not available, or are not accessible to most of those at highest risk of infection. All the single-dose treatments, aciclovir, and some antiretrovirals are on the WHO essential medicines list,[45] although availability is not guaranteed.

There are interventions for individuals that are still being tested in trials—e.g., male circumcision. Many observational studies have indicated strong protection against the acquisition of ulcerative sexually transmitted infections[46] and HIV,[47] but confounding by cultural and sexual behaviour cannot be fully accounted for. Three randomised controlled trials in South Africa, Uganda, and Kenya are therefore investigating efficacy. The first trial was stopped after interim analysis showed a 60% reduction in the acquisition of HIV infection.[48] Effects on the frequency of genital ulcer disease and other sexually transmitted infections from any trial are not yet known. Other interventions—e.g., the vaginal microbicide nonoxinol 9—are now known not to protect against either HIV or other sexually transmitted infections.[36] Alternative microbicide preparations against HIV are being assessed in trials but most of these have no activity against other sexually transmitted infections.[49]

Vaccines

The first vaccine that protected against a sexually transmitted infection was hepatitis B vaccine, which was tested in men who have sex with men in the USA.[24] A new vaccine (Gardasil, Merck, New Jersey, USA), licensed in June, 2006, and in Europe in September, 2006, offers a high level of protection against some strains of HPV infection in previously unexposed women. The vaccine contains non-infectious virus-like particles of the major capsid antigen L1 of HPV types 16 and 18, which

Search strategy and selection criteria

We searched MEDLINE and the Cochrane Library until July, 2006, to identify systematic reviews and guidelines that summarised evidence about the effectiveness of interventions to control sexually transmitted infections. We also used the results of our own systematic reviews of evidence for the effectiveness of antenatal syphilis and chlamydia screening programmes[39] and partner notification.[42] For these reviews, we searched MEDLINE, Embase, Cinahl, the Cochrane Controlled Trials Register, PsycINFO, the Database of Abstracts of Research Effectiveness, and SIGLE. We had no language restrictions. For chlamydia screening we searched the databases from January, 1990, to December, 2005, with subject heading and free text terms that combined Chlamydia trachomatis/infections or pelvic inflammatory disease with terms for screening. For partner notification we searched the databases from January, 1990, to December, 2005, with subject heading and free text terms that combined contact tracing/partner notification with terms for individual sexually transmitted infections. For both reviews we identified relevant articles published before 1990 from the reference lists of retrieved articles. For antenatal syphilis screening we searched all databases from the earliest date to December, 2005, and also searched Old MEDLINE from 1950 to 1965. For every database we used subject headings and free text terms that combined Treponema pallidum, syphilis, congenital syphilis, and spontaneous abortion or stillbirth with terms for screening. All searches were updated in August, 2006.

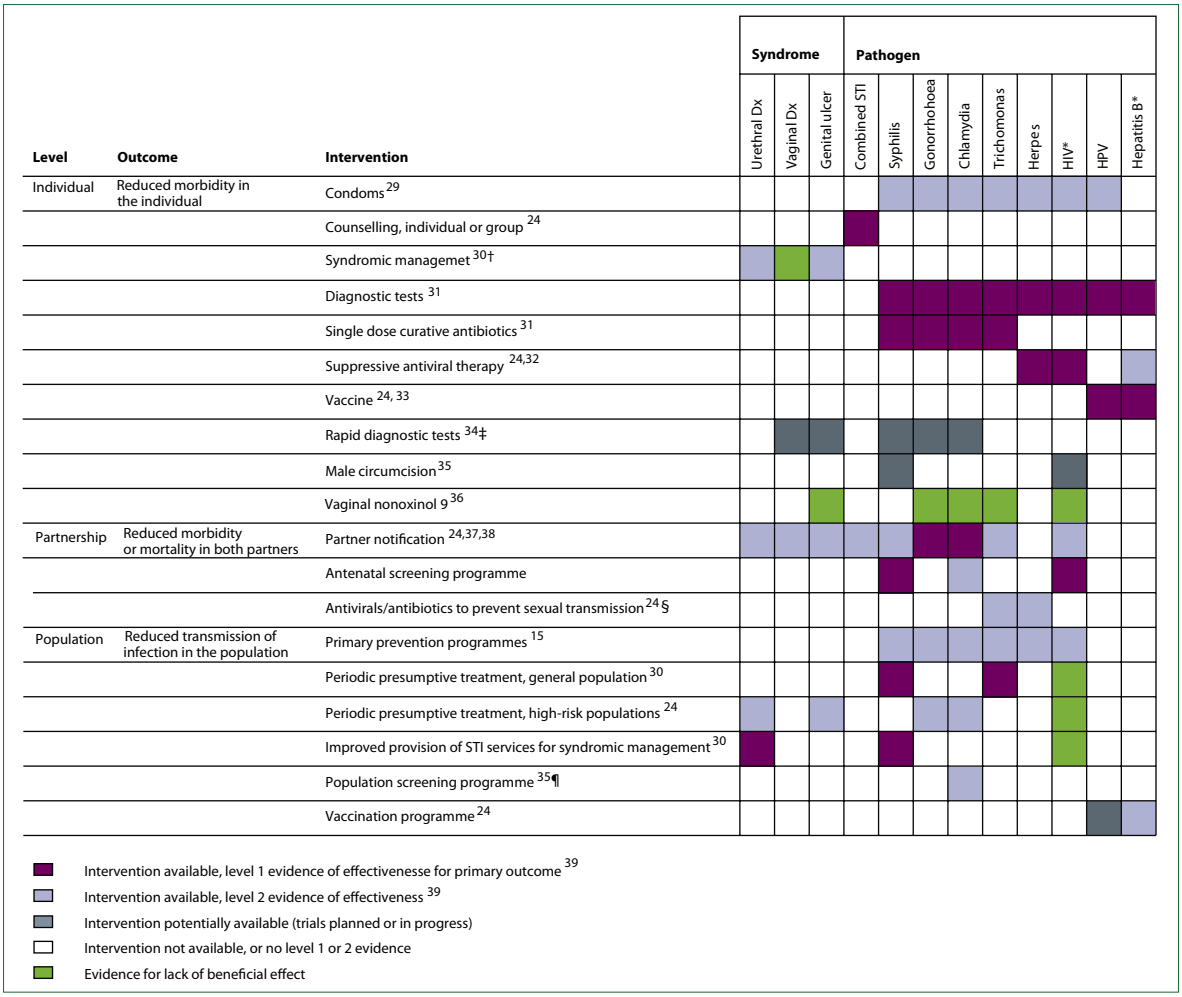

Figure 3: Effectiveness of interventions for controlling sexually transmitted infections
Dx=discharge. HPV=Human papillomavirus. STI=sexually transmitted infection. *Includes only interventions to prevent sexually transmitted HIV and hepatitis B. †Evidence for absence of benefit of syndromic management for vaginal discharge when prevalence of sexually transmitted infections is low. ‡Rapid diagnostic tests being assessed by STD Diagnostics Initiative. §Interventions include treating male partner of women with trichomoniasis to prevent reinfection in the woman, and suppressive valaciclovir to index case in HSV-2 discordant couples. ¶Evidence is categorised as level 2, because level 1 evidence is available only for prevention of pelvic inflammatory disease in individuals.

cause cervical cancer, and types 6 and 11, which cause genital warts. In restricted analyses of women who completed the three-dose vaccine schedule without major protocol violations in four phase II and III trials, there were no cases of type 16 or 18 associated cervical intraepithelial neoplasia grade 2 or 3 in the 8487 women who received the vaccine compared with 53 cases in 8460 women who received placebo.[33] The vaccine also prevented 99% of warts caused by HPV 6 and 11. Efficacy was, however, only about 36% in women who had already been infected with HPV. A second candidate vaccine (Cervarix, GlaxoSmithKline, Middlesex, UK) against HPV 16 and 18, which has shown some cross-protection against other high-risk HPV types,[50] is expected to be licensed in 2007. Vaccines against HSV have shown transient, part protection only (panel 2),[51] and there are currently no vaccines against any other sexually transmitted infection.

Syndromic management

The greatest deficiency in individual case management in resource-poor settings is the scarcity of cheap and accurate diagnostic tests. Syndromic management remains the core intervention in the WHO strategy for delivering prevention and care for people with sexually transmitted infections in resource-poor settings where laboratory testing is not available.[15] Syndromic management involves the use of simple flowcharts to help health-care workers identify groups of symptoms and easily recognisable signs (syndromes) and guide treatment that covers the most probable causes of the syndrome.[42] Treatment of patients at the first visit avoids loss to follow-up and provides an opportunity for education, advice on sexual behaviour, promotion or provision of condoms, and partner notification. The syndromic approach, which can be used at all levels of health care,[52,53] treats mixed infections, and prospective studies provide some evidence of effectiveness in the management of symptomatic urethritis and epididymitis in men, and genital ulcer disease in both women and men where syphilis and chancroid are common causes.[40,52] However, HSV type 2 is emerging as the most common cause of genital ulcer disease,[54] and WHO guidelines recommend incorporation of aciclovir into the syndromic treatment package for genital ulcers when the proportion of ulcers due to HSV type 2 is greater than 30%.[42] Trials are being done to determine if this intervention could also reduce the transmissibility of HIV infection (panel 2).

The syndromic flowchart for the management of vaginal discharge does not work well for controlling sexually transmitted infections in women because this symptom is a poor proxy for endocervical chlamydia and gonorrhoea.[11,52] Sensitivity and specificity remain low even when supplemented by speculum examination and risk assessment, which are often either unavailable or culturally inappropriate.[40,61] In Matlab, Bangladesh, only three of 320 women with abnormal vaginal discharge had chlamydia or gonorrhoea. The poor specificity of the algorithm in this low prevalence population (56%) meant that 36–87% of costs would have been spent on uninfected women.[61] Even in settings where the prevalence of endocervical infections is more than 15%, fewer than one in three women diagnosed syndromically will have a sexually transmitted infection.[52] The use of flowcharts for vaginal discharge has been suggested to provide treatment for vaginal sexually transmitted infections (trichomonas) and endogenous reproductive tract infections (bacterial vaginosis and candidosis).[52,61] In south Asia, up to 25% of women who present to primary health centres have vaginal discharge, but this finding is more likely to be part of a culturally related or psychosomatic illness than a sexually transmitted or reproductive tract infection.[11,62] Apart from increased drug costs, overtreatment of vaginal discharge exposes women to the side-effects of multiple drugs, changes in the vaginal flora that might then exacerbate the symptoms and possible risks of gender-based violence as a result of notifying partners about sexually transmitted infections.[13]

Panel 2: Potential for syndromic management of genital ulcer disease to reduce HIV transmission

Herpes simplex type 2 (HSV-2) infection is replacing syphilis and chancroid as the most common cause of genital ulcer disease in many developing countries.[54] HSV-2 increases the risk of acquiring HIV by three times[55] and of transmitting HIV.[56] Conversely, HIV-induced immunosuppression might increase susceptibility to HSV-2, increase HSV- 2 shedding,[57,58] and increase severity of clinical manifestations.[59]

Vaccine trials have shown only some efficacy so far. An HSV-2 glycoprotein D vaccine induced part protection from clinical disease (73%) and overall HSV-2 transmission (40%), but only in women with no previous exposure to either HSV-1 or HSV-2, and there was no protection in men or HSV-1-seropositive women.[51]

Treatment for HSV-2 is becoming cheaper. Suppressive therapy reduces transmission to sexual partners in the immunocompetent,[34] and might reduce HIV transmission in immunosuppressed people with recurrent HSV-2. In HIV-infected women with herpes, a proof of concept randomised trial in Burkina Faso showed that women receiving valaciclovir for 3 months had fewer episodes of HIV vaginal shedding (odds ratio 0·46, p=0·003) and lower HIV plasma viral load (0·39 log copies per mL reduction) than did women who received placebo (0·12 log copies per mL increase).[18]

Three randomised controlled trials in Malawi, South Africa, and Ghana and Central African Republic are now assessing the effect on HIV genital shedding of incorporating episodic aciclovir into the syndromic management of genital ulcer disease. Preliminary data from the South African trial show that, in the first 127 HIV-positive participants enrolled, 52 (41%) were shedding HIV from genital ulcers at the baseline visit (median 272 copies per mL, range 51–100 000 copies per mL; G Paz-Bailey, Global AIDS Program for Central America, Centers for Disease Control and Prevention, Guatemala; personal communication). Other trials in Africa, Latin America, and the USA are assessing suppression of HSV-2 to reduce susceptibility to HIV in HIV-negative, HSV-2 seropositive individuals and to reduce infectiousness of HIV in individuals with HIV/HSV-2 co-infection.[60]

WHO already recommends that aciclovir should be available in developing countries for patients with primary herpes, those with severe episodes, immunosuppressed patients, and patients with frequent recurrences.[42] If episodic aciclovir reduces HIV shedding to the same degree as suppressive valaciclovir, it could have an important role in the reduction of HIV transmission.

Rapid point-of-care tests

Cheap, accurate, point-of-care tests are especially important for causal diagnosis of sexually transmitted infections that are undiagnosed or misdiagnosed by syndromic approaches, especially in women.[34,63] The multiagency Sexually Transmitted Diseases Diagnostics Initiative[33] sponsors a research programme to identify and assess rapid tests for use in resource-poor countries that are accurate, sensitive, specific, user-friendly, rapid, robust, equipment free, and delivered to settings where they are required. A range of tests for syphilis has been field tested, the most promising of which are undergoing further assessment. Tests for chlamydia and gonorrhoea are also priorities. A new dipstick test, with monoclonal antibodies to label chlamydial lipopolysaccharide from any serovar, has shown sensitivity of 83·3% and specificity of 98·5% compared with PCR for identifying trachoma-associated *Chlamydia trachomatis* serovars.[64] If the point-of-care test has the same performance in genital specimens, clinical management of individuals with chlamydia would improve substantially. Even if cheap and widely available, however, better diagnostic tests used in symptomatic populations will not reduce the prevalence of asymptomatic sexually transmitted infections. Such a reduction needs a screening programme to identify the reservoir of infection. Identification of the population at risk, high uptake, appropriate treatment and partner notification, and regular repeated screening are all needed for a screening programme to be effective.[65]

Partnership interventions

Interventions for partnerships provide an opportunity to begin to break chains of transmission, either by reducing the risk of transmission from the infected person (often called the index case) to an uninfected partner or fetus, or by preventing reinfection from an infected partner to a treated person. Antivirals given to suppress recurrences of genital herpes in immunocompetent people can reduce transmission to susceptible partners.[32] In nearly 1500 serodiscordant couples given once daily valaciclovir or placebo for 8 months, 0·5% of partners in the valaciclovir group compared with 2·2% of partners in the placebo group acquired symptomatic HSV type 2 (hazard ratio 0·25, 95% CI 0·08–0·75).[32] Because of the co-factor effect of genital ulcer disease in enhancing the transmissibility of HIV infection, suppression of genital herpes could prevent transmission of HIV to susceptible sexual partners of people with both HIV and herpes (panel 2).

Partner notification

Partner notification is, by definition, a partnership-based intervention that aims to prevent onward transmission of infection. If successful, such an intervention will also prevent re-infection in the infected person. Partner notification is a process that includes informing sexual partners of infected people of their exposure, administering presumptive treatment, and providing advice about the prevention of future infection.[66] Partners can be informed by the patient (patient referral), the health professional (provider referral), or by the health professional if the patient has not done so within an agreed time (contract or conditional referral). In

practice, patient referral is the most commonly used, and is the preferred, method.[37,38] A range of partner notification approaches can increase the numbers of sexual partners treated for people with gonorrhoea, chlamydia, syphilis, HIV, trichomonas, and sexually transmitted infection syndromes, but this is a proxy outcome that assumes that partner treatment prevents onward spread.[24,37,38,41] Only recently have trials been large enough to show that the risk of reinfection or persistent infection in index cases can also be reduced. When compared with basic patient referral, four trials in which index cases received antibiotics or prescriptions to give directly to their partner(s) (patient-delivered partner therapy) showed a reduced risk of reinfection with gonorrhoea or chlamydia (summary relative risk 0·72, 95% CI 0·58–0·88).[38] For transmission to be interrupted in the population, enough partners of the partners of index cases have to be traced and treated, and their partners likewise, to have an effect. The absence of a population effect of existing partner notification interventions is unsurprising when the average number of sexual partners treated per index case with gonorrhoea or chlamydia is about 0·5.[67]

Outcomes show that partner notification is a difficult intervention to do well. All the problems of stigma, blame, relationship breakdown, and the increased possibility of gender-based violence come to the fore when someone has to tell their partner(s) that they might have a sexually transmitted infection. Partner notification is an integral component of syndromic management,[15] which is inaccurate in many settings. Randomised controlled trials of partner notification for syndromically diagnosed infections in Uganda and Zimbabwe show that quarrelling and fighting, and actual or feared physical violence are indeed problems.[68,69] Therefore, the public-health aims of infection control have to be weighed carefully against the welfare of the patient, and decisions about appropriate interventions assessed carefully for every setting and individual.[70]

Antenatal screening

Sexual partnerships are not the only partnerships implicated in transmission. When sexually transmitted infections affect pregnant women, fetuses and newborn infants can also be infected and die. Antenatal screening programmes are good examples of interventions that use efficacious single interventions—e.g., diagnostic tests and antibiotics—but for which effectiveness in prevention of transmission is dependent on delivering them in an organised, sustainable way, in a receptive environment. Evidence of the effectiveness of antenatal screening programmes can be difficult to establish, perhaps because of perceived ethical difficulties of randomly assigning pregnant women to interventions that are believed to be effective. Intramuscular penicillin for pregnant women with syphilis can prevent congenital syphilis, but there are no trials that establish the optimum regimen.[71] Randomised controlled trials show that treating chlamydia in pregnancy cures the pregnant woman,[72] but evidence of the benefit to neonates comes from cohort studies.[73] For these interventions to be effective, however, a present and functioning health system needs to identify women through screening programmes. Panel 3 shows how interventions to improve the effectiveness of antenatal syphilis screening have been assessed and implemented.

Population-based interventions

Population-based interventions to control sexually transmitted infections are complex and can incorporate multiple individual and partnership-based interventions. Every intervention should be shown to be effective alone, and when combined in the way in which they are to be delivered as a programme. Ultimately, interventions for the population are delivered to individuals but it is the population-based aims, coordination, organisation, and monitoring of delivery and outcomes that define these as programmes rather than interventions for individuals.

Control of sexually transmitted infections to prevent HIV transmission

Community-based interventions to control sexually transmitted infections in the general population in sub-Saharan Africa have some effect on syphilis and other infections but provide apparently conflicting results about whether or not they reduce the risk of HIV transmission.[24,30] Two trials in the general population included an intervention to improve the accessibility and infrastructure of government health services for providing syndromic management in Mwanza, Tanzania,[86] and Masaka, Uganda.[87] A third trial, in Rakai, Uganda, provided antibiotic treatment every 10 months to all adults.[88] Reduction of the frequency of other sexually transmitted infections was a secondary endpoint in all trials, and a meta-analysis has shown that, overall, these interventions were effective: the relative risk of any sexually transmitted infection in intervention compared with control communities was 0·83 (95% CI 0·79–0·86).30 Specifically, the frequency of syphilis fell in intervention villages in all three trials, urethritis and gonorrhoea fell in the trials in Mwanza[86] and Masaka,[87] respectively, and trichomonal infections fell in Rakai.[88] There was no effect on chlamydia infection in any trial. The frequency of HIV infection was reduced only in the Mwanza trial.[86] A further trial in adolescents in Mwanza[89] showed no effect on HIV frequency.

Mathematical modelling studies that investigated differences in the results of the general population trials in Mwanza, Masaka, and Rakai suggest that improved services and mass treatment had much the same effect on sexually transmitted infections.[90] The effect on HIV transmission, however, was dependent on the role of concurrent sexually transmitted infections in promoting new HIV infections in epidemics at different stages. The earlier phase of the HIV epidemic in Mwanza and higher frequencies of risky sexual behaviour and curable sexually transmitted infections at the time of the intervention could explain the greater effect on HIV incidence in Mwanza than in the Ugandan trials.[91] Strengthening services to provide consistent high-quality treatment of symptomatic sexually transmitted infections is therefore deemed to be an important intervention for limiting the spread of HIV in countries with low-level concentrated epidemics, especially when access is secured for vulnerable populations, including sex workers, their clients and regular partners, men who have sex with men, people with a sexually transmitted infection, and sexually active adolescents.[15]

Periodic presumptive treatment

Presumptive treatment is a one-time treatment given for a presumed infection. Presumptive treatment given at regular intervals is known as periodic presumptive treatment. In theory, this approach should reach a greater proportion of people with sexually transmitted infections than treating only those with symptoms, and avoids the costs of diagnostic tests. The interval between treatments must, however, be short enough to avoid re-infection. In Rakai, Uganda, treatment at 10-month intervals had little effect on transmission in the general population, with a reduction in long-term syphilis reactivity and trichomonal infections but no effect on gonorrhoea, chlamydia, bacterial vaginosis, or reports of urethral discharge, vaginal discharge, or genital ulcers.[88] The reductions in infection were outweighed by the operational requirements of

implementation. Presumptive treatment has therefore been suggested as a temporary strategy to reduce prevalence as part of a package of services in some populations at high risk of infection whereas other curative and preventive services are being established. In female sex workers given monthly single-dose antibiotics in Benin, Ghana, and Kenya, however, only one of three randomised controlled trials, in Kenya, showed a reduction in chlamydia and gonorrhoea.[24] The intervention had no effect on HIV acquisition. Periodic presumptive treatment has not been assessed in other groups—e.g., men who have sex with men.

Population screening programmes

Chlamydia is the only sexually transmitted infection for which organised population screening now takes place. The population endpoint of screening for asymptomatic chlamydia is to have identified and treated enough infections for transmission in the community to decrease,[91] and for chlamydia prevalence to have fallen (panel 4). There are also individual and partnership aims. For individual women, having an early endocervical chlamydial infection treated should reduce the risk of pelvic inflammatory disease, ectopic pregnancy, and infertility. Reduction of transmission to partners would be achieved by partner notification.

The opportunistic screening approach used in existing national chlamydia control activities, in England,[91] Sweden,[95] and the USA,[96] has not been assessed in randomised controlled trials.[35] Opportunistic screening means that people are offered the opportunity to be tested for chlamydia at the time of a health-care consultation, or attendance at another selected setting, usually for an unrelated reason.[65] The alternative approach is proactive screening, which requires the use of a population register to identify in advance those who should be offered screening, and invite them to have a test at regular pre-specified intervals (also known as active, systematic, register-based, or call-recall screening). The organisational difference is important: regular screening is harder to achieve with opportunistic screening. If uptake is modest and irregular, the average screening interval will be long enough to allow chlamydia transmission to continue and limit the impact of screening (panel 4). Randomised controlled trials have shown the efficacy of chlamydia screening in preventing pelvic inflammatory disease, but the screening approach in these trials was proactive, rather than opportunistic.[35]Two randomised trials in the USA and Denmark have shown a reduction in pelvic inflammatory disease of about 50%.[97,98] One trial in Inuit communities recorded a fall in chlamydia prevalence after 1 year of screening in intervention villages but not in communities for which only opportunistic screening was offered, but baseline differences and the absence of analysis that took clustering into account make these results difficult to interpret.[99] Time-series studies showing falling chlamydia, pelvic inflammatory disease, and ectopic pregnancy rates in the early 1990s in Sweden and the USA have been interpreted as evidence of the success of opportunistic screening.[100–102] These decreases, however, happened at the same time that large-scale HIV prevention campaigns promoting safer sex were credited with reducing rates of sexually transmitted infections in countries that did not have chlamydia screening pro-grammes at that time.[103,104] In Sweden, which has the most longstanding national chlamydia control activities, the prevalence of chlamydia has actually increased, and in 2005 was the highest ever recorded.[105] At present, there are no examples of national chlamydia screening programmes using a screening approach that has been assessed in a randomised controlled trial, although a pilot study of proactive screening with mailed home-collected specimens will begin in the Netherlands in 2007.

Panel 3: Improving the effectiveness of antenatal syphilis screening

Antenatal screening and treatment to eliminate congenital syphilis is a global health priority[74] and is universally regarded as effective.[75] Interventions to improve the effectiveness of existing antenatal syphilis screening have focused on a strategy of decentralised testing: providing rapid syphilis testing on site, training staff to do the test, and starting treatment on the same day to increase uptake, and avoid loss to follow-up and delays in starting treatment.[76] There are failures at all levels, however, even when policies exist: from women's lack of awareness of the existence or severity of syphilis, through an absence of services and logistical difficulties in existing clinics, to a scarcity of political will at the top.[77] The result is that 30% or more of all pregnant women receive no antenatal care,[78] and the average first visit at 5–6 months is too late to prevent congenital syphilis.[9] One of the main barriers for women who do attend antenatal clinics is the complicated process for syphilis testing, which is usually done in a central hospital laboratory, despite the simplicity of the rapid plasma reagin test.

Three comparative studies[79–81] and five reports from demonstration projects in Kenya[76,82–84] and Haiti[85] done over the past 15 years show that providing access to technical interventions alone does not improve outcomes. One cluster randomised controlled trial, providing decentralised screening to women in seven intervention clinics in Kwa-Zulu Natal, South Africa, showed no effect compared with seven control clinics on congenital syphilis rates, despite reducing the time to first injection by 16·3 days (95% CI 12·7–19·8).[79] Two non-randomised cluster studies, however, showed that in Lusaka, Zambia, rates of treatment, partner notification and spontaneous abortion and stillbirth fell after the introduction of decentralised screening,[80] and in Maputo, Mozambique, fewer infants of mothers with syphilis died in the first week of life and fewer had positive syphilis serology at birth than those in control clinics.[81] The difference in the results is probably because in both the non-randomised studies, on-site screening was only one component of a package that also provided health promotion, training, partner management, and regular supplies to intervention but not control sites. Effects in the intervention areas might also have been overestimated because clustering was not accounted for in the analyses.

Demonstration projects are usually set in only one area to assess the implementation of an intervention under field conditions, supported by the training and infrastructure that would be desirable in a full-scale programme. In rural Haiti, provision of sustained access to equipment and training for community workers to do decentralised syphilis screening was associated with a reduction in congenital syphilis rates from 1996 to 2001.[85] In Nairobi, Kenya, decentralised screening was implemented in nine of 30 public clinics with maternal and child health services in 1992 to 1993.[76] Antenatal syphilis testing soon after initiation was nearly 100%, 87% of seropositive women were treated at the first visit, and half of partners were treated. Subsequent changes in seroprevalence were attributed to the changing logistical situation.[82] By 1997 to 1998, uptake of antenatal screening in intervention clinics was reported to be higher (79%) than in non-intervention clinics (56%), but the gestational age at presentation (25 weeks) and proportion of seropositive women treated were much the same, and the proportion seropositive at delivery was the same as at the initial visit.[83] Difficulties with sustainability meant that this[84] and other programmes have not been scaled up in the long term.

Panel 4: Use of mathematical modelling to show the potential effect of population screening for chlamydia

Mathematical modelling can show the importance of regular and high coverage of screening programmes for asymptomatic chlamydia to interrupt population transmission and hence reduce prevalence.

Mathematical modelling is a powerful method for the investigation of the epidemiology and control of sexually transmitted infections.[92] By use of a hypothetical population, they can show the likely effect of an intervention under different conditions. To obtain credible estimates of the effect on cases of infection or complications prevented, the modelling approach must incorporate the dynamic interactions between individuals. The most realistic representations come from stochastic simulation models that allow individual partnerships to be formed and dissolved,[90,92–94] and differential sexual mixing according to levels of sexual activity to be specified.[92–94] These models are computationally complex, require many assumptions, and can be difficult to interpret.[92]

We investigated the effect of a programme targeted at sexually active 16–25 year olds that recommends annual screening. The actual proportion of people tested every year was taken from studies that achieved low (35%)[94] or high (64%) uptake.[93] We used an individual-based transmission dynamic model[93,94] that used empirical data to specify sexual mixing by activity, duration of partnerships, concurrent partnerships, condom use, age differences between women and men, performance of nucleic acid amplification diagnostic tests, the proportion of people treated with single-dose azithromycin, and the proportion that received partner notification. We used estimates of chlamydia transmissibility and duration of untreated infection from previous models.[93] *Chlamydia trachomatis* was introduced into the population and the steady state prevalence after 5000 days used as the baseline. The model was run 30 times for all options, on a population of 50 000 individuals for 15 000 simulated days every time. The prevalence of chlamydia was recorded every 20 days by sex and 5-year age bands.

The figure shows how the uptake of chlamydia screening offered to either women only, or to women and men, affects chlamydia prevalence in 16–25 year olds after 10 years of screening. If the uptake of long-term screening of women only were 35%, chlamydia prevalence would be expected to fall by about 10% (from 4·4% to 3·9%). The greatest proportional reduction was seen when screening uptake in both women and men was high, and the starting prevalence low. With all scenarios, screening led to a reduction in chlamydia prevalence, which reached a new, lower, steady state after about 2 years.

Screening programmes might direct additional resources to groups with the most risky sexual behaviour—e.g., sex workers, their clients, migrant workers, and those attending sexually transmitted diseases clinics. The table shows that if targeted screening could reach 100% of women in the highest activity group every year and no-one else was screened, the reduction in population prevalence would be about the same as screening 35% of all groups. A screening programme that reaches 35% of women and men in the general population and all women and men at highest risk would have the greatest effect.

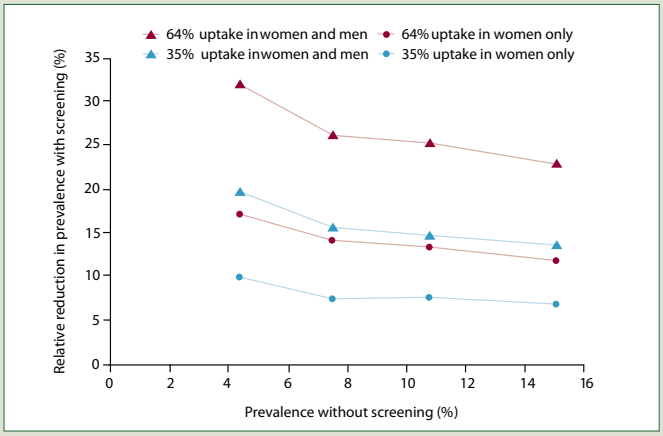

Figure : **Effect of chlamydia screening uptake on prevalence**

	Prevalence after 10 years (%)		
	Start of programme	Screen women only	Screen women and men
35% uptake in all sexual activity groups	4.4%	3.9%	3.5%
64% uptake in all sexual activity groups	4.4%	3.6%	3.0%
100% uptake in highest activity group, no screening in rest of population	4.4%	3.8%	3.0%
100% uptake in highest activity group plus 35% in rest of population	4.4%	3.6%	2.7%

Table: Effect of general population and targeted screening on chlamydia prevalence

Vaccination programmes

Hepatitis B and HPV vaccines are efficacious at preventing infection in unexposed individuals. However, delivery to a high proportion of the population at risk is a challenging goal. Sexual intercourse is the most common route of transmission of hepatitis B in developed countries,[106] and hepatitis B vaccine was originally tested in men who have sex with men. However, the vaccine was not heavily promoted for the prevention of sexually acquired hepatitis, and completion of the full three-dose course in men who have sex with men in countries such as the USA and UK remains poor.[106,107] In endemic areas in the rest of the world, perinatal and childhood transmission are the most important routes. The inclusion of hepatitis B vaccine in the WHO Expanded Programme on Immunisation schedules at birth (in 153 countries in 2004) will have the greatest effect on transmission and, eventually, on sexual transmission.

Vaccination programmes against HPV infection could save the lives of many of the 274 000 women who die from cervical cancer every year.[108] Screening programmes to identify and treat endocervical squamous cell abnormalities have been the mainstay of prevention, and have reduced mortality substantially in high-income countries. As with chlamydia, however, the organisation of screening and follow-up is not affordable or feasible in many resource-poor settings. About 80% of cases and 80% of deaths from cervical cancer now occur in resource-poor countries, with 25% of the global burden in India alone.[109]

HPV presents new challenges for those developing vaccination programmes—e.g., issues related to HPV as a sexually transmitted infection, how to achieve maximum coverage, and who will benefit most. As a sexually transmitted infection, HPV is common and is usually acquired soon after sexual debut, so vaccination will have to be given to girls of age 9–12 years, before they start to become sexually active.[110] Governments, communities, and parents will have to deal with the misperceptions that a vaccination to prevent a sexually transmitted infection will promote premature sexual activity. They will also have to understand the need to vaccinate young children against a disease that occurs decades later. Cancer prevention agencies will have to manage their concerns that promotion of HPV vaccine as an intervention against a sexually transmitted infection might reduce its acceptability and undermine efforts to promote it as cancer prevention.[109]

The optimum age for HPV vaccination of girls is outside the target age groups of the Expanded Programme on Immunisation. Tetanus toxoid should be given to young women, but global coverage is only 50% and much of this proportion is given to parous women,[110] which is too late for HPV vaccination. To reach 9–12-year-old girls in school-based programmes will be difficult, since 42% of girls in sub-Saharan Africa and 29% in south Asia are not in school at this age.[111] Annual immunisation campaigns might be the only feasible option. Existing sexual and reproductive health services will have an important role in catch-up campaigns and in reaching other target populations such as men who have sex with men.[107] There are still doubts about the vaccine's performance in Africa, where the prevalence of HPV is highest.[110] Overcoming these difficulties, however, could provide the pathways to successfully introducing a vaccine for HIV in the future.

Opportunities for delivering interventions

The integration of public-health interventions—e.g., screening and vaccination programmes—into a broad range of sexual and reproductive health-care services has the potential to reach a high proportion of sexually active adults, especially women. Since the 1994 Cairo International Conference on Population and Development, the international community has had a global commitment to provide integrated sexual and reproductive health care to meet the needs of young people, men, and women throughout the life cycle. This commitment has been specifically understood to include the provision of integrated services for prevention and care of sexually transmitted infections in primary health care. Figure 4 shows the proportion of married women with a reversible method of contraception as a proxy for the proportion using family planning services, and the proportions of sexually active women and men who had symptoms associated with sexually transmitted infections, and who sought treatment, based on data from Demographic and Health Surveys.[112] In many countries, a substantial proportion of those with symptoms had not sought care. Provision of interventions to control sexually transmitted infections in family planning clinics, antenatal clinics, and maternal and child health clinics might reduce missed opportunities for prevention, detection, and treatment.[15] Stronger evidence for the benefits of integrating services in any area of health care is, however, needed.[113] For sexually transmitted infections, a randomised trial of integrated services has been done only in female sex workers at truck stops in Tanzania.[113]

Key populations for control interventions

Populations at high risk of sexually transmitted infections include sex workers, their clients and non-paying partners, men who have sex with men, people with a sexually transmitted infection, including those with HIV infection, and sexually active adolescents.[15] For these groups, access to services to treat sexually transmitted infections is often restricted because they are marginalised or criminalised. Young people, especially women, are highly vulnerable, but strategies for delivering accessible, acceptable, and effective services have not been determined in many settings.[114] In many countries in Africa and central and southeast Asia the proportion of adolescent women who use modern contraceptive methods is lower than for older women[112] because health services are available only to married women and adolescents often need permission from a parent or a spouse to attend.[112]

Men are more likely than women to be the primary source of sexually transmitted infections in many marital and cohabiting relationships. Men do seek sexual health care, but such care tends to be in the unregulated private sector, which traditionally has had little incentive to participate in achieving public-health goals.[115] However, public health and sexual and reproductive health communities need to work with the multifaceted private sector in most countries to ensure that interventions and services reach men as well as women.[15,115]

Discussion

We need to control sexually transmitted infections effectively because of the substantial morbidity and mortality that they cause in their own right, not merely because they can facilitate HIV transmission. By recognising that these infections, by their transmissible nature, affect not only individuals, but their partners as well, and that control interventions work at many levels, to take a public-health approach makes sense. The WHO draft global strategy for prevention and control of sexually transmitted infections recommends that this approach includes promotion of safer sexual behaviour and early health-care seeking behaviour, horizontal implementation of prevention and care across all primary health-care services, comprehensive case management, implementation of evidence-based strategies, and surveillance that

includes monitoring of sexual behaviour.[15] Evidence-based strategies make use of technical interventions that work in individuals, and can be combined in a coordinated way to be delivered as programmes for specific groups or whole populations. Any programme should also be shown to work in the way in which it is to be delivered to the population before being implemented.

Stigma and moralising are not the only barriers to engaging policymakers in tackling sexually transmitted infections. If we cannot say how many cases of infection could be prevented by an intervention, nor how much it will cost, policymakers will put their money into interventions whose benefits have been quantified. The absence of basic data is therefore a major limitation to lobbying for and promotion of effective interventions. There are three types of problem. First, surveillance is often poor. The prevalence, cause, and antimicrobial resistance patterns of sexually transmitted infections, and sexual behaviour indicators are unknown in many settings, so determining optimum treatment packages for

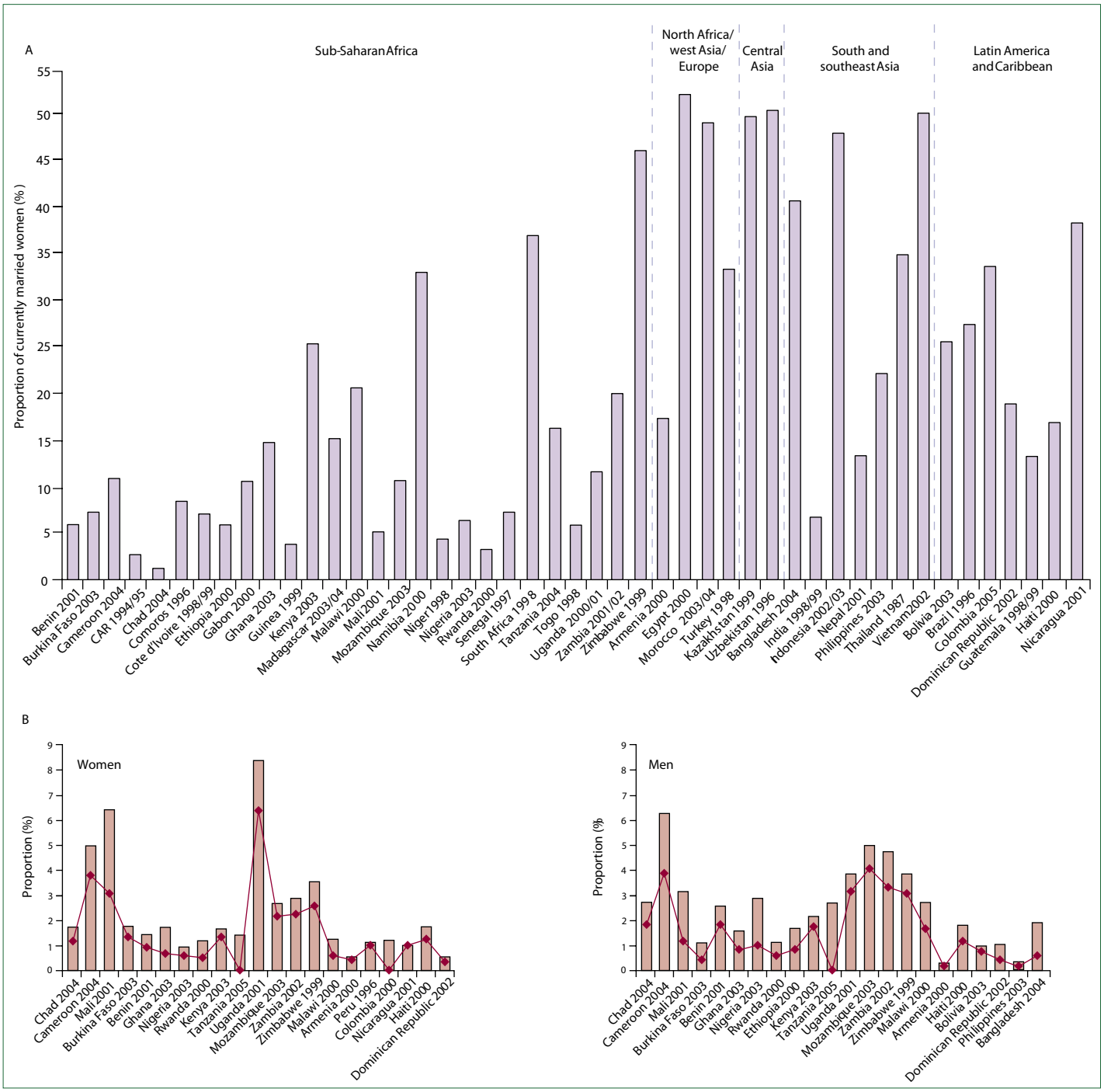

Figure 4: Use of sexual and reproductive health services by the general population
(A) Proportion of women currently using modern contraceptive methods (including the pill, intrauterine device, injection, diaphragm, foam, jelly, condom).
(B) Proportion of sexually active women (left) and men (right) who reported with any symptoms of a sexually transmitted disease (bars) or who sought treatment with trained personnel in the past year (line). Source: Demographic and Health Surveys.[112]

syndromic management and monitoring the effect of interventions is not possible. Second, there is uncertainty about the transmissibility, duration of infection, and natural history of many sexually transmitted infections. For example, the progression rate of untreated endocervical chlamydial infection to the upper genital tract is not well established and might be much lower than previously thought.[116] This possibility has substantial implications for decisions about the cost effectiveness of interventions such as chlamydia screening,[117] because it is the resources saved by preventing costly complications such as tubal infertility that make an intervention attractive. Third, we need credible estimates from modelling studies of the effect and cost effectiveness of control interventions. Unlike non-communicable conditions, there are computational complications in analysing and modelling the transmission of sexually transmitted infections through complex networks, especially when they do not cause longlasting immunity.[90] Standard static modelling techniques cannot take into account the indirect effects of transmission of infection: future cases prevented on the one hand, but an increase in the number of people rendered susceptible by detection or treatment on the other (panel 4).

The selection and implementation of strategies and policies is still fraught with problems for most programme managers. All too often, programme content is determined by external factors, especially funding bodies, that favour one intervention above others.[118] For example, syndromic management for sexually transmitted infections was heavily promoted worldwide throughout the 1990s, even when information about local contexts suggested that the intervention was inappropriate in some settings.[11] Moreover, even when a policy such as antenatal syphilis screening has been placed on the agenda, formulated, and adopted, implementation is not guaranteed if the political environment is not supportive.[119] The Reproductive Tract and Sexually Transmitted Infections Programme Guidance Tool[120] is an action-oriented strategic planning process that enables decision makers to set goals and directions and to prioritise interventions for addressing the problem of reproductive tract infections, including sexually transmitted infections. Assessments in Brazil, Ghana, Latvia, and China have shown its usefulness in assisting programme managers to select from the range of available options, rather than focusing on a single-intervention approach to programme design. Nonetheless, the assessment also emphasised the role that broader issues of health sector reform had in determining which interventions were eventually implemented.

Conclusions

The massive global response to the HIV/AIDS epidemic has to continue, but not at the expense of controlling other sexually transmitted infections for which financial resources and support have decreased over the past 5 years.[15] Investment in effective population-based control of sexually transmitted infections will bring independent benefits and help achieve other MDGs of gender equality, and improved child and maternal health, even if they are not a named priority. Where there are links with HIV/AIDS prevention then these should be strengthened—e.g., integration of antenatal syphilis screening into programmes to prevent mother-to-child HIV transmission. In return, the delivery of high quality comprehensive services for management of sexually transmitted infections can restrict the spread of HIV in early concentrated epidemics. Effective action needs a complex multifaceted approach that addresses the historical, cultural, and political context within which service delivery decisions are made and programmes delivered.[2] Strong advocacy and leadership are needed at global and country level to provide clear messages about the importance of controlling sexually transmitted and other reproductive tract infections, identify the interventions and programmes that work, identify the constituencies that affect resource allocation, and create multidisciplinary and multisectoral coalitions to influence decision makers.[14] We must not allow stigma, prejudice, and moral opposition to obstruct the goals of infectious disease control.

Conflict of interest statement

We declare that we have no conflict of interest.

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