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The effect of syndromic management interventions on the prevalence of sexually transmitted infections in South Africa

Leigh F. Johnson [a,*], Rob E. Dorrington [b], Debbie Bradshaw [c], David J. Coetzee [a]

[a] Centre for Infectious Disease Epidemiology and Research, Faculty of Health Sciences, University of Cape Town, Anzio Road, Observatory 7925, South Africa
[b] Centre for Actuarial Research, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa
[c] Burden of Disease Research Unit, South African Medical Research Council, P.O. Box 19070, Tygerberg 7505, South Africa

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ABSTRACT

Few studies have assessed the effect of syndromic management interventions on the prevalence of sexually transmitted infections (STIs) at a population level. This study aims to determine the effect of syndromic management protocols that have been introduced in South Africa since 1994.

Study design: A mathematical model of sexual behaviour patterns in South Africa was used to model the incidence of HIV, genital herpes, syphilis, chancroid, gonorrhoea, chlamydial infection, trichomoniasis, bacterial vaginosis and vaginal candidiasis. Assumptions about health seeking behaviour and treatment effectiveness were based on South African survey data. The model was fitted to available STI prevalence data.

Main outcome measures: Reductions in STI prevalence due to syndromic management.

Results: Between 1995 and 2005, there were significant reductions in the prevalence of syphilis, chancroid, gonorrhoea, trichomoniasis and chlamydial infection. In women aged between 15 and 49, syndromic management resulted in a 33% (95% CI: 23–43%) decline in syphilis prevalence, a 6% (95% CI: 3–11%) reduction in gonorrhoea prevalence, a 5% (95% CI: 1–13%) reduction in the prevalence of bacterial vaginosis and a substantial decline in chancroid. However, syndromic management did not significantly reduce the prevalence of other STIs. For all STIs, much of the modelled reduction in STI prevalence between 1995 and 2005 can be attributed to either increased condom usage or AIDS mortality.

Conclusions: Syndromic management of STIs can be expected to decrease the prevalence of curable STIs that tend to become symptomatic, but has little effect on the prevalence of STIs that are mostly asymptomatic.

Introduction

Sexually transmitted infections (STIs) are a major contributor to the burden of disease in many developing countries [1]. Because of the difficulties associated with treating STIs in developing countries, the World Health Organization introduced syndromic management guidelines for the treatment of STIs and other reproductive tract infections in the early 1990s [2]. This strategy aims to treat all STI patients according to the symptoms with which they present, rather than deferring treatment until the results of laboratory tests are available. Apart from the obvious benefit to the patient of receiving immediate treatment, this strategy circumvents problems that may be experienced with limited laboratory facilities, coordination of patient receipt of test results, the high cost of laboratory tests and the limited sensitivity of certain tests [2,3].

STI interventions such as this aim to eliminate infection at the individual level, as well as to reduce the prevalence of STIs at a population level [4]. However, most evaluations of syndromic management protocols for STI treatment have focused on their impact at the individual level [5], and only two community randomized controlled trials have assessed their impact at a population level [6,7]. Several studies have documented declines in STI prevalence in African populations [8–13], but it is difficult to determine the extent to which these reductions are attributable to improved STI treatment, as observed reductions in STI prevalence could also be attributable to changes in sexual behaviour [14] or AIDS mortality [15].

In the absence of strong evidence from controlled trials, the impact of syndromic management on STI prevalence at a population level can be evaluated using mathematical models, provided that these models are appropriately calibrated to local STI prevalence and treatment data, and provided that the models make appropriate allowance for other factors that may cause reductions in STI

Abbreviations: HSV-2, herpes simplex virus type 2; IEC, information, education and communication; STI, sexually transmitted infection.

* Corresponding author. Tel.: +27 21 406 6981; fax: +27 21 406 6764.
E-mail addresses: Leigh.Johnson@uct.ac.za (L.F. Johnson), Rob.Dorrington@uct.ac.za (R.E. Dorrington), Debbie.Bradshaw@mrc.ac.za (D. Bradshaw), David.Coet zee@uct.ac.za (D.J. Coetzee).

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prevalence (i.e. behaviour change and AIDS mortality) [16,17]. Such evaluations are particularly important in view of the growing scepticism regarding the benefits of syndromic management in HIV prevention [18], and can provide important insights into the reasons why syndromic management may fail to achieve significant reductions in STI prevalence at a population level.

This study aims to assess the likely effect of syndromic management protocols on STI prevalence levels in South Africa, a developing country with high levels of STI prevalence, which introduced syndromic management guidelines in its public health sector in 1994. Declines in the antenatal prevalence of syphilis have been observed over the last decade, and the South African Department of Health has attributed these to the success of the syndromic management programme [19]. However, there has been no formal evaluation of the extent to which improvements in STI treatment are responsible for the reduction in the prevalence of syphilis, and a lack of nationally representative data concerning the prevalence of other STIs has been an obstacle in assessing trends in the prevalence of these STIs [20]. This paper proposes a Bayesian modelling approach to evaluate the effect of syndromic management on the prevalence of STIs and other reproductive tract infections.

Methods

A mathematical model was developed to project the growth of the South African population over time, starting in 1985. The sexually active population is stratified by age, sex, marital status, propensity for concurrent partnerships, number of current partners, and risk group of partner(s). Individuals are assumed to move between these sexual activity states over time, and the rates at which they move between states are fixed at the mean values estimated in a previous analysis of South African sexual behaviour data [21]. Assumptions about coital frequency and condom usage are specified by age, sex and relationship type, with condom usage being highest in interactions between sex workers and their clients, lower in other non-marital relationships, and lowest in marital relationships. Levels of condom usage are also assumed to increase over time, in line with national surveys conducted in 1998, 2003 and 2005 [22–24], which showed increases in condom use at last sex from 16% to 56% in young women, up from levels of close to zero in the late 1980s [25]. Since there is little evidence of other forms of behaviour change in South Africa [26], no other spontaneous changes in sexual behaviour are assumed. A more detailed description of the modelling of sexual behaviour is provided elsewhere [21,27].

The spread of HIV and other STIs is simulated by making assumptions about the probability of transmission per act of unprotected sex, and individuals are assumed to progress through a series of symptomatic and/or asymptomatic states in the absence of treatment. These assumptions have been described previously in the case of HIV [21], syphilis, gonorrhoea, chlamydial infection and trichomoniasis [28], and the assumptions in respect of herpes simplex virus type 2 (HSV-2) and chancroid are described in Supporting information (Online appendix). The model also allows for the incidence of bacterial vaginosis and vaginal candidiasis in women, as described in Supporting information (Online appendix).

Individuals experiencing symptoms of discharge, dysuria or genital ulcers are assumed to seek treatment at a rate that depends on their age and sex. In adults aged 20 and older, the rate at which treatment is sought is assumed to be 0.23 per week in women and 0.57 per week in men, based on reported treatment delays and proportions of cases treated in a number of South African studies [29–32]. Since rates of health seeking for STI symptoms appear to be lower in adolescents [33,34], and higher in commercial sex workers [29,34], the rate at which adolescents seek treatment is assumed to be half of the rate in older adults, and the rate at which sex workers seek treatment is assumed to be 0.90 per week. Based on South African studies [29,30,35–37], it is assumed that the public health sector treats 45% of men and 60% of women who seek treatment, and the formal private sector treats 40% and 30% respectively. The remainder of individuals seeking treatment are assumed to seek treatment from traditional healers. No provision is made for antibiotic self-treatment or treatment by other 'informal' providers, as antibiotic access is tightly controlled in South Africa [38] and pharmacists are not permitted to sell antibiotics without a prescription [36,39].

The proportions of health workers following syndromic management protocols are assumed to differ between the public and formal private health sectors, and are assumed to increase over time (Table 1). Although syndromic management guidelines were introduced rapidly after 1994, recent surveys suggest that 10–30% of public sector nurses do not know the correct drugs for common STI syndromes [40,41], and the proportion of public sector health workers correctly applying syndromic management protocols is therefore assumed to remain constant at 80% after 2000. Private practitioners have been relatively slow to adopt syndromic management protocols, but the proportion of providers using these protocols is assumed to increase by 2% per annum from 2000 to 2006, as the proportion of providers trained in the use of the new guidelines increases [42]. The model also allows for the effect of drug shortages in public STI clinics, which are assumed to become less common over time (Table 1). In addition, the model allows for the antenatal screening of syphilis, as described elsewhere [27,28].

STI treatment effectiveness is assumed to depend on the individual STI and on whether syndromic management protocols are used (Table 2). The assumed proportions of cases that are provided with effective treatment, if health workers do not follow syndromic management protocols, are based on studies of STI treatment practices prior to the adoption of syndromic management protocols [46–50]. Providers who follow syndromic management guidelines are assumed to provide effective treatment, except in three cases: (1) male trichomoniasis, which is currently only treated with metronidazole if the patient fails to respond to the initial treatment [51]; (2) vaginal candidiasis, which is only treated if clinically suspected [51,52]; and (3) genital herpes, which was not provided for in South African treatment guidelines [52] until very recently [53]. If effective treatment is provided, the STI is assumed to be cured in 90% of cases [54–58]. In the case of vaginal candidiasis and bacterial vaginosis, which are more difficult to treat effectively, separate allowance is made for "complete cure" and "partial cure" (resolution of symptoms while still having intermediate vaginal flora or asymptomatic vaginal candidiasis) [59–62]. Treatment provided by traditional healers is assumed not to be effective.

To take account of the uncertainty regarding the effectiveness of STI treatment prior to syndromic management, as well as uncertainty regarding many of the other STI parameters, an uncertainty analysis was conducted. The uncertainty analysis, which follows a Bayesian approach, is described in detail elsewhere [28]. Briefly, prior distributions were specified to represent the uncertainty regarding the key parameter values for each infection, and 20,000 parameter combinations were randomly drawn from these prior distributions. For each parameter combination, a likelihood value was calculated, to represent the "goodness of fit" to observed STI prevalence data, when the parameter combination was entered into the mathematical model. Information regarding the STI prevalence data used in calculating the likelihood values is provided in Table 3; all data were collected in independently conducted sentinel surveys in different communities, and the statistical definition of the likelihood takes into account differences in study populations and diagnostic accuracy. A posterior sample of 500 parameter