The cost-effectiveness of a competitive voucher scheme to reduce sexually transmitted infections in high-risk groups in Nicaragua

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Current evidence suggests that sexually transmitted infection (STI) interventions can be an effective means of human immunodeficiency virus (HIV) prevention in populations at an early stage of the epidemic. However, evidence as to their cost-effectiveness when targeted at high-risk groups is lacking. This paper assesses the cost-effectiveness of a competitive voucher scheme in Managua, Nicaragua aimed at high-risk groups, who could redeem the vouchers in exchange for free STI testing and treatment, health education and condoms, compared with the status quo (no scheme). A provider perspective was adopted, defined as: the voucher agency and health care providers from the public, NGO and private sectors. The cost of the voucher scheme was estimated for a 1-year period (1999) from project accounts using the ingredients approach. Outcomes were monitored as part of ongoing project evaluation. Costs and outcomes in the absence of the scheme were modelled using project baseline data and reports, and relevant literature.

The annual cost of providing comprehensive STI services through vouchers was US$62 495, compared with an estimated US$17 112 for regular service provision in the absence of the scheme. 4815 vouchers were distributed by the voucher scheme, 1543 patients were tested for STIs and 528 STIs were effectively cured in this period. In the absence of the scheme, only an estimated 85 cases would have been cured from 1396 consultations. The average cost of the voucher scheme per patient treated was US$41 and US$118 per STI effectively cured, compared with US$12 per patient treated and US$200 per STI cured in its absence. The incremental cost of curing an STI through the voucher scheme, compared with the status quo, was US$103. A voucher scheme offers an effective and efficient means of targeting and effectively curing STIs in high-risk groups, as well as encouraging quality care practices.

Key words: cost-effectiveness, vouchers, sexually transmitted infections, sex workers

Introduction

Sexually transmitted infections (STIs) enhance the transmission of HIV by increasing the infectiousness of HIV-positive individuals and/or the susceptibility of HIV-negative persons (Holmes et al. 1999; Mabey 2000; O'Farrell 2002; Buchacz et al. 2004). STI prevention has therefore been explored over recent years as a channel to HIV prevention. An STI intervention is more likely to show a measurable impact at an early stage of an epidemic, when a greater proportion of HIV infections occur in the more sexually active members of the population, in whom STI prevalence is higher (Hayes et al. 1995). There is also evidence to suggest that it is easier to persuade individuals to make use of improved STI treatment services which are accessible, effective and free of charge than to achieve substantial and lasting changes in sexual behaviour (*ibid*). Reciprocally, by improving STI services, more STIs (even those which are asymptomatic) will be detected, concurrently increasing awareness about risks and promoting safer sexual behaviour. Indeed, it has

been suggested that men who have been diagnosed with an STI use condoms with consistently greater frequency than those who have not (Gorter et al. 2000).

Numerous studies have estimated the cost-effectiveness of STI prevention programmes for the general population (Gilson et al. 1997; Chesson and Pinkerton 2000; Sahin-Hodoglugil et al. 2003). Recent studies have also estimated the cost-effectiveness of education programmes for STI prevention in high-risk groups, through peer education (Hutton et al. 2003) and mass media (Chesson et al. 2002). However, at the time of writing, there were no published cost-effectiveness studies of STI treatment in high-risk groups in a less developed country setting.[1]

In Managua, Nicaragua, a period of formative research revealed that sex workers were reluctant to use government STI services, due to associated stigmatization. Subsequently, the quality of STI diagnosis and treatment protocols were assessed by observing medical practice,

examining knowledge levels in a sample of medical doctors and through mystery patients.[2] Diagnosis and treatment were found to be based almost entirely on symptoms, in the public, non-governmental organization (NGO) and private sectors, whilst none of the medical doctors interviewed were familiar with syndromic treatment of STIs.

In order to encourage service uptake and effective treatment of STIs in high-risk groups, a competitive[3] voucher scheme was set up and implemented in Managua, Nicaragua. The scheme targeted female sex workers and their clients, transvestites and adolescent glue-sniffers (male and female) who could redeem vouchers in exchange for free STI testing and treatment in any one of a number of private or NGO clinics contracted in advance by the voucher agency. The scheme was designed to increase the utilization of STI services by a population at risk of HIV by increasing the financial accessibility of the services and reducing the associated stigma. It also served to strengthen the capacity of providers to deliver high (technical and human) quality care, and to detect and treat a higher number of STIs. The aim was ultimately to contain the spread of the HIV virus within the high-risk groups and to other sectors of the population.

This paper presents the average costs of treatment with and without the voucher scheme as well as an incremental cost-effectiveness analysis of the voucher scheme compared with the status quo (what would have happened in the absence of the scheme) from the provider perspectives of: the voucher agency (Instituto Centro-Americano de la Salud [ICAS], a Central American NGO conducting health research); collaborating NGOs; government; private and NGO health service providers.

Methods

Study site

The intervention took place in Managua, the capital of Nicaragua, a city of 1 106 600 million people (2002 estimate). Nicaragua has a relatively low incidence of HIV/AIDS; the prevalence among adults in the general population is estimated at 0.2% (UNAIDS/WHO 2004), increasing to 2% in the sex worker population (Gorter et al. 2000, 2004b).

Practice in the absence of the voucher scheme

Prior to the introduction of the voucher scheme, STI treatment services were available at government, NGO and private clinics. All 12 government health centres in the capital provided these services during an outpatient service often referred to as 'Clínica 13'. As this service was stigmatized, sex workers usually opted for treatment at general outpatient clinics, without declaring their profession. In addition to the government sector, several NGOs (such as Profamilia and SiMujer) have networks of integrated reproductive health centres and numerous

medical practitioners provide private care from either their home or policlinics.

The baseline survey revealed that standard treatment protocols included a range of antibiotics: penicillin or doxycycline for gonorrhoea,[4] doxycycline for chlamydia, metronidazol for trichomoniasis and penicillin for syphilis (Ministry of Health 1993). Little provision for health education was available (Braddock 1995; Gorter and Sandiford 1995–1999). Laboratory facilities were available at all facilities, but appropriate tests for the more common STIs were absent, with the exception of syphilis and trichomonas.

The baseline survey revealed that 45% of sex workers (including female glue-sniffers) and 15% of males (glue-sniffers, transvestites and clients) went for an STI check-up in the year prior to the start of the voucher scheme. Nearly half of these went to public clinics, with around 40% of female high-risk groups using NGO clinics (10% for males), and about 10% using private facilities (40% for males). Given the symptomatic approach to STI treatment and a high proportion of asymptomatic cases, especially among female sex workers, the numbers effectively diagnosed and treated are likely to have been low.

Intervention

Against this background, a voucher scheme was set up in Managua by ICAS in 1995 to increase access to improved STI treatment services for high-risk groups, and has been running on an ongoing basis since then.[5] Following the mapping of the city's sex worker population and the baseline survey, clinics were invited to tender and a medical protocol was established to standardize and guarantee the quality of care provided by the medical personnel (Gorter et al. 1999). The study population and intervention design have been described fully elsewhere (Gorter et al. 1999, 2000; Sandiford et al. 2000, 2002), but a summary follows.

Vouchers are distributed to sex workers,[6] their regular clients and/or partners, transvestites, and male glue-sniffers in Managua at 6-monthly intervals (and can be redeemed for up to 3 months after the initial distribution). They are then entitled to a range of free services from any one of between 7–12 private and NGO clinics contracted in advance by the voucher agency. For patients testing positive for STIs, and/or pregnant women, an additional voucher is provided giving them the opportunity to return for a repeat consultation at a future date. The services offered include: a medical consultation; screening tests for syphilis, and trichomoniasis, candidiasis, gardenerella and cervical cancer (Papanicolaou smear) in the case of female redeemers; diagnosis of other STIs through physical examination; and health education including the provision of an information booklet, especially designed for sex workers, and 24 condoms during each visit. Presumptive treatment with a single-dose of 1 gram of azithromycin is offered to all redeemers, which treats several STIs such as

chlamydia and gonorrhoea. Evaluation was integrated as an important part of the intervention, hence, medical forms, exit interviews and parallel laboratory testing were carried out to ascertain the quality of the services and treatment provided by the clinics and their effectiveness in reducing the prevalence of STIs.

Analysis of costs

Costs in the absence of the voucher scheme

In order to estimate the costs of what would have happened in the absence of the voucher scheme, we considered the same population size as those receiving vouchers. The proportion seeking STI treatment and frequency were estimated from a baseline survey of 337 sex workers and interviews with 574 first-time male voucher redeemers about care-seeking behaviour before the voucher scheme. This survey enabled us to assess proportions using public, NGO and private facilities.

It was assumed that the baseline prevalence of STIs would be independent of the voucher scheme, and so we used the diagnostic records of STI prevalence in female and male voucher redeemers collected in 1999 by clinics participating in the voucher scheme.

Given the low numbers presenting with condilomata, and the absence of effective treatment for genital herpes, we only considered the cost of treating the four most frequent STIs, listed in Table 1. The cost of a Papanicolaou smear test was also included, assuming 72% of the females seeking STI treatment had a smear test (baseline survey).

In the absence of medical records to estimate cure rates for those receiving STI treatment in the absence of the voucher scheme, we compiled estimates from the literature of percentages presenting with symptoms, and made assumptions about diagnosis rates and treatment effectiveness using baseline survey results, medical records and laboratory test results, as shown in Table 1. The cure rate was calculated as the product of the percentage presenting with symptoms, getting diagnosed and receiving correct treatment.

The estimates of unit costs of STI consultations were derived from a study carried out in 1995 (Braddock 1995), which included two government health centres, three NGO facilities, one private practitioner and a private policlinic. For public and NGO facilities, the marginal cost (staff time, medical and non-medical supplies) was used to give a lower limit estimate of the cost of service provision. Private facility costs were estimated as the amount paid by patients for a consultation. The drug costs in the public sector were taken from the national pharmaceutical centre supplying public facilities. Private and NGO service providers do not have access to this supplier, and prices of generic medicines from national suppliers in the commercial sector were approximately three times higher (Braddock 1995).

For those who had a check-up but were not successfully diagnosed, the cost estimate consists only of staff time and supplies, whilst successful diagnosis and treatment also includes the cost of drugs and medical supplies. We assumed that only syphilis cases would be referred for laboratory tests and have a follow-up consultation (Gorter and Sandiford 1995–1999).

Table 1. Assumptions about cure rates[a]

STI considered	Females			Males		
	% with symptoms[b]	% getting diagnosed if symptoms present[c]	% correct treatment[d]	% with symptoms[b]	% getting diagnosed if symptoms present[c]	% correct treatment[d]
Gonorrhoea	0.30	0.20	0.81	0.70	0.80	0.81
Chlamydia	0.30	0.10	0.88	0.50	0.10	0.88
Syphilis[e]	0.05	0.40	0.70	0.20	0.50	0.70
Trichomoniasis[f]	0.50	0.50	0.72	n.a.	n.a.	n.a.

[a]We assumed that diagnosis and cure rates do not differ by type of facility (public, private or NGO).
[b]Data sources: Holmes et al. (1999), Morré (1999) and a comparison of clinical symptoms with laboratory results in medical records from voucher beneficiaries.
[c]Based on laboratory and medical data from the voucher scheme.
[d]Based on the results of an examination of medical doctor's STI knowledge (percentage mentioning at least one effective antibiotic). For syphilis, almost all doctors could mention an effective antibiotic, and therefore the figure is based on the percentage of patients returning for a follow-up consultation and effectively receiving treatment (Gorter and Sandiford 1995–1999).
[e]The figures in the table relate to women with syphilis who have symptoms (5% of all women), of which 40% would be diagnosed and 70% treated: $5\% \times 40\% \times 70\% = 1\%$. Syphilis in women is not usually diagnosed as the chancre is often not visible and is painless. Therefore syphilis is most commonly detected in pregnant women when routine screening is performed. Ten percent of the sex workers who redeemed a voucher were pregnant. Of those, normally 82% would receive an antenatal check-up (INEC & MINSA 2001). For these cases, the cure rate is 6% ($= 10\% \times 82\% \times 70\%$).
[f]The figures in the table relate to women with trichomoniasis, who were not detected through a Papanicolaou smear test. For those who have a smear test (72% of all those seeking STI treatment) and receive the result of the test (88% of this group), trichomoniasis would be detected in 61% of cases (estimated from laboratory test results of the voucher programme). Of these, 72% would receive correct treatment, so 28% ($72\% \times 88\% \times 61\% \times 72\%$) of those having a smear test would be cured.

Intervention costs

We estimated the yearly costs of running the voucher scheme retrospectively from the perspective of the provider. As we were interested in the costs of incorporating the intervention into the national health system, research and related consultancy costs were excluded from the analysis. Due to gaps in available expenditure and the changing nature of the scheme, costs and effects were estimated for a 12-month period from February 1999 to 2000.

An ingredients approach to costing was adopted. Resource use was combined with costs by interviews with project staff and reviewing project accounts. Costs were classified by recurrent items, including personnel, drugs and medical supplies, office materials, transport, maintenance, communication and refreshments, and by capital items, including vehicle, equipment and overhead costs (these were annualized over their expected life time). Costs were also classified by voucher scheme activities, as defined in Table 2. Resources shared between activities were allocated through interviews with relevant staff members on the basis of estimated time spent.

Two NGOs collaborated with the project: Associacion de Trabajadores para la Educación, Salud y Integración Social (TESIS) and Comunidad Eclesiales de Bases San Judas (CEBS). They have close links to specific groups of sex workers that would have otherwise been hard to reach. They assisted in the distribution of vouchers and the transportation of glue sniffing adolescents and sex workers of the lowest socio-economic strata, and therefore also incurred expenditure as a result of their support to the scheme, in terms of personnel, supplies, communication and administration, which was not covered by the voucher agency. To estimate these costs, staff from each organization were interviewed and their accounts reviewed.

All costs were converted to US$ from Cordoba using the official exchange rate for 1999 (US$1 = 11.81 Cordoba).

Costs to users

A survey of 31 sex workers was carried out to capture and quantify the direct costs associated with redeeming a voucher in terms of transport, drugs not covered by the voucher, and any drinks or snacks purchased during the waiting time in the clinic. Time was valued at the average hourly rate if the activity was sex work ($2.5 per hour [SD 2.0]), or the average daily rate of pay to the childminder (US$2.1) if the activity was childminding, and zero for 'non-productive' activities (such as housework). For companions and clients, the official minimum wage was used for valuing their time (estimated at US$42 per month).

Prices charged in NGO and private facilities in the absence of the voucher scheme were taken from the study by Braddock (1995).

Measurement of effectiveness and cost-effectiveness

Effectiveness was defined in terms of the number of STIs treated and effectively cured in patients presenting with one or more STI.[7] Average costs were estimated as the total cost of service provision divided by these effectiveness measures. The incremental cost-effectiveness ratio is defined as the difference between the cost of the voucher scheme and the do-nothing alternative, divided by the difference in STIs treated and cured.

Sensitivity analysis

A series of one-way sensitivity analyses were conducted to assess the impact of changes in uncertain variables on the average cost of curing an STI and the incremental cost-effectiveness ratio. With unemployment in Nicaragua estimated at over 50%,[8] salaries are very low compared with neighbouring countries, yet high compared with sub-Saharan African countries with similar HIV prevalence. We considered the impact on results of a change by a factor of $+/-0.5$. We also considered the impact of a 10% increase/decrease in the STI cure rate under the voucher scheme. The cure rates in the absence of the voucher scheme are more uncertain, and therefore were doubled in order to assess the impact on results. The price of

Table 2. Description of voucher scheme activities included in the cost analysis

Activities	Description
Health care delivery	Consultations, health education sessions, tests and results, follow-up consultation visits, drugs and condoms provided.
Administration of health care delivery	Contracting of clinics and delivery of clinical record sheets; the ordering, transport and distribution of drugs and medical supplies to the clinics.
Individual training workshops	Training provided to doctors, nurses, receptionists and NGOs.
Voucher distribution	Printing and fabrication of the vouchers, distribution and supervision by project team and participating NGOs.
Supervision and quality control	All research activities non-essential to the provision of health care *per se*: provision of medical forms to be filled by the doctors during the gynaecological consultation and follow-up visit, and quality control testing of 10% of gonorrhoea cultures.
'Support' activities	Monthly rental of office space plus cost of utilities (excl. telephone), cleaning and secretarial support.

condoms distributed under the voucher scheme was subject to variation during the lifetime of the project, initially purchased at US$0.02, later increasing to US$0.07 due to a change in model. We therefore used US$0.07 as an upper limit value, and US$0.01 as a lower limit value, which reflects the price of locally produced condoms in India. Given the uncertainty around the unit costs of an STI consultation in the public and NGO sectors in the absence of the scheme, we considered the effect of increasing the unit cost to the average cost of an outpatient visit (total health centre bill by the total number of patients) minus variable costs.

Finally, it is likely that the cost of laboratory tests and gynaecological consultations will vary significantly depending on the setting. Table 3 indicates upper and lower estimates of prices used in the sensitivity analysis and taken from a literature review by Mumford et al. (1998).

Using the estimates from this table we conducted a best- and worst-case scenario analysis, using the combined lower price estimates (best case) and then the combined upper price estimates (worst case).

Results

The total annual cost of the voucher scheme was US$62 495. Personnel accounted for almost half the total cost, with 18% for drugs and medical supplies and 11% for office supplies. The direct medical costs associated with health care delivery through the contracted clinics represented 63% of the total (Table 4), more than half for laboratory test and gynaecological consultations. Voucher production and distribution accounted for 21% of the total. Supervision and quality control accounted for 6%. This compared with an estimated US$17 112 for health service delivery in the absence of the scheme (Table 5).

In 1999, the voucher scheme effectively cured 528 out of 577 STIs, during 1543 consultations and 1205 follow-up consultations, of which 28% were chlamydia, 25% were syphilis or chancroid, 19% were gonorrhoea, 19% were trichomoniasis and 8% other (condyloma). The voucher scheme also distributed 71 300 condoms. In the absence of the voucher scheme, only an estimated 85 STIs would have been cured from 1396 consultations.

Under the voucher scheme, the average cost per consultation (voucher redeemed) was US$41 and the average cost per STI cured was US$118. The average cost per consultation in the absence of vouchers was estimated at US$12; the cost per STI cured at US$200. The cost of curing the additional 443 STIs through the voucher scheme, and providing a more comprehensive and higher quality service, was US$45 383 per year. The incremental cost-effectiveness ratio was US$103 per STI cured.

Sensitivity analysis

The results were most sensitive to increases in the cost of service provision in the absence of vouchers, as well as the prices of resource inputs used in the voucher scheme (reduction in personnel costs and an increase in the cost of lab tests). The results were not sensitive to reductions in condom prices, but were sensitive to increases in

Table 4. Distribution of the costs of the voucher scheme by activity

Activity	Total cost	Percentage of total cost
(1) Health care delivery		
Gynaecological consultation	4 619	7
Health education	5 237	8
Laboratory analyses	12 392	20
Follow-up consultation	6 110	10
Drugs during 1st consultation	4 229	7
Drugs during 2nd consultation	1 855	3
(2) Administration of health dare delivery		
Contracting clinics	871	1
Ordering/distributing drugs	3 761	6
Total health care (1+2)	*39 074*	*63*
(3) Training workshops	2 280	4
(4) Voucher distribution activities	12 861	21
(5) Supervision and quality control	3 480	6
(6) Support activities	4 800	8
TOTAL	62 495	100

Table 3. Upper and lower limits used in sensitivity analysis for the cost of health care and laboratory services

Variable	Baseline (US$)	Lower limit in 1999 prices (US$)	Country (Source)	Upper limit in 1999 prices (US$)	Country (Source)
Gynaecological consultation	$3.90	$2.89	Zimbabwe (Collins et al. 1995)	$9.21	Mexico (Suarez and Brambila 1994)
Syphilis diagnostic test	$3.75	$0.68	Tanzania (Kigadye et al. 1993)	$11.05	Assumption based on average between consultation and pap smear
Pap smear	$2.77 (voucher) $4.23 (no voucher)	$2.41	Zimbabwe (Mitchell et al. 1999)	$12.89	Honduras (Bratt et al. 1993)

Note: We did not subject the less common tests – LLETZ, biopsy and colposcopy – to sensitivity analysis due to the lack of relevant international literature.

Table 5. Projected service use and costs with and without the voucher scheme

	No voucher scheme				Voucher scheme
	Public	Private	NGO	Total	
Number of consultations					
Female sex workers	516	146	397	1 059	1 106
High-risk males	140	144	53	337	437
Number of STIs cured					
Female sex workers	30	9	23	62	318
High-risk males	10	10	3	23	210
Unit costs					
Consultation costs (no treatment)	0.78	28.19	2.16	–	–
Consultation and treat gonorrhoea	6.67	45.87	19.84	–	–
Consultation and treat chlamydia	1.11	29.17	3.14	–	–
Consultation and treat trichomoniasis	0.94	28.67	2.64	–	–
Consultation and treat syphilis	6.24	63.37	9.90	–	–
Papanicolaou smear*	4.92	31.86	6.48	–	–
Total cost					
Female sex workers	2 256	7 518	2 762	12 536	–
High-risk males	157	4 258	161	4 576	–
All combined	2 413	11 776	2 923	17 112	62 495

*Includes the cost of a follow-up visit in 88% of cases.

condom prices. The incremental cost-effectiveness ratio fell to US$83 with a 50% reduction in personnel costs (Table 6), in line with salaries in sub-Saharan Africa, and to US$86 if we use average minus variable cost instead of marginal cost as a proxy for the unit cost of a medical consultation in the absence of the voucher scheme. The results were also sensitive to changes in the effectiveness of services provided: a 10% reduction in the cure rate under the voucher scheme increases the incremental cost-effectiveness ratio to US$116, and a doubling of the cure rate in the absence of the scheme increases it to US$127. Only if the cure rate in the no-voucher scenario doubles from that assumed at baseline does the average cost per STI cured fall below that of the voucher scheme.

Costs to users

The total direct cost (including transport, snacks and limited medical expenses) to voucher redeemers was US$4.46 (SD 5.3). Eighty-seven per cent of the respondents lost income as a result of attending the clinic, with two having to pay for someone to look after their children during their visit. The average opportunity cost of time was US$2.64.

In the absence of the voucher scheme, users would have to spend an additional US$5.10 for a consultation in NGO facilities, increasing to US$28.19 in a private clinic (not including the costs of drugs and lab tests). Due to frequent shortages in the availability of drugs and medical supplies in the public sector, users are likely to face additional charges for these items, as well as the opportunity cost of time due to additional waiting. Therefore, the voucher scheme clearly saves users both time and a considerable amount of money.

Discussion

Whilst there have been numerous studies of the cost-effectiveness of STI treatment programmes in the general population (e.g. Gilson et al. 1997), at the time of writing, there were no such studies that had been published of interventions targeting high-risk groups in developing countries. Meanwhile, these groups are frequently exposed to STIs and, when infected, can transmit infection to many susceptible partners. For this reason, the number of secondary infections averted by preventing or curing STIs in sex workers has been estimated to be more than 100 times greater than in the general population (Over and Piot 1993; Steen and Dallabetta 2003). Thus, although high-risk groups are more difficult to reach than the general population, the impact of targeting these groups in terms of STI, and specifically HIV, prevention is much greater, especially in lower HIV-prevalence settings.

Whilst the voucher scheme cost more than service provision in the absence of vouchers, it was successful in reaching high-risk groups, providing them with an affordable and high quality service and treating 92% of the four most frequent STIs. In the absence of vouchers, only 15% of STIs would have been cured, with obvious implications for the spread of STIs and, ultimately, HIV. This was made possible through the use of a highly effective treatment protocol (combining presumptive treatment, laboratory tests, clinical diagnosis and effective antibiotics), and by signalling to medical staff the risk status of patients through vouchers. Furthermore, the voucher scheme reached a higher proportion of those subgroups with the highest STI rates, female glue-sniffers and market-based sex workers (Gorter et al. 2000). As STIs were treated more efficiently and effectively,

Table 6. Sensitivity of results to changes in key variables

Change carried out	Total cost		Difference	STIs cured		Difference	Average cost per STI cured		Incremental cost per STI cured
	Voucher	No voucher		Voucher	No voucher		Voucher	No voucher	
Reduce personnel costs by 50%	47 512	10 965	36 547	528	85	443	90	129	83
Increase unit costs of service provision in absence of voucher scheme	62 495	24 259	38 236	528	85	443	118	285	86
Best case scenario for price of consultations and lab tests	55 310	14 163	41 147	528	85	443	105	167	93
Baseline	*17 112*	*17 112*	*45 383*	*528*	*85*	*443*	*118*	*200*	*103*
Reduce voucher scheme cure rate by 10%	62 495	17 112	45 383	475	85	390	132	200	116
Double the cure rate in the absence of the scheme	62 495	17 112	45 383	528	170	358	118	100	127
Increase condom prices (US$0.07)	74 129	17 112	57 017	528	85	443	140	200	129
Worst case scenario for price of consultations and lab tests	93 666	26 350	67 310	528	85	443	177	310	152

the average cost per STI cured was US$82 lower with vouchers than without. The voucher scheme is an effective and efficient means of curing STIs in high-risk groups.

Ideally, the cost of effectively treating one STI case should be seen in conjunction with the number of additional STI, and particularly HIV, cases averted. Unfortunately, this was not possible here due to the nature of the target population (all sex workers and other high-risk groups in the area were targeted) combined with the sample size requirements in a low HIV-prevalence setting. For both these reasons, neither a case control study nor a randomized trial could easily be conducted. However, the scheme was successful in its intention to avert HIV cases, the management of which would have borne significant costs to society in terms of both the direct medical costs (and hospitalization costs) of treating each case and the substantial non-medical costs (in terms of lost productivity) associated with the premature deaths of young adults (Booysen et al. 2002; Skordis and Nattrass 2002). Not to mention the curtailing of a potential epidemic. In addition, we did not include the resource savings associated with the management of additional non-HIV STI morbidity, yet this has been shown to be significant (Yeh et al. 2003).

Furthermore, whilst condom use was promoted as part of the scheme, this indicator of effect was not included in the cost-effectiveness analysis due to the difficulty of attributing precisely the extent to which the scheme was responsible for any change in behaviour. However, condom use was encouraged during health education sessions as part of the gynaecological consultation provided to voucher redeemers, which is also likely to have made voucher redeemers more receptive to prevention messages (Family Health International 2001). Observational studies carried out by the scheme indicate that condom use increased from 37% in 1990 (field workers checked rooms for left condoms containing semen) to 56% in 1997 (Gorter et al. 1993; Egger et al. 2000).

The sensitivity analyses showed that the scheme's cost-effectiveness was very sensitive to changes in personnel costs, and that cost-effectiveness would increase significantly were the scheme to be replicated in countries with lower personnel costs. Results were also sensitive to the estimated unit costs of service delivery in the absence of the voucher scheme, with the incremental cost-effectiveness ratio falling to US$86 if the average minus variable cost figures were used instead of marginal costs. It is also likely that the voucher scheme would benefit from economies of scale, in the case of expansion to a larger population.

With annual total public health expenditure in Nicaragua estimated at US$105 million, investment in the voucher scheme represents 0.043%, which appears to be an affordable means of curtailing the spread of HIV and other STI infections in a low prevalence setting, especially if the medical savings in terms of averted HIV cases are taken into account.

The voucher scheme resulted in significant cost savings to users, as services were provided for free upon presentation of the voucher. However, users may still incur transport costs, added to the value of time foregone travelling to and from the facility and waiting, suggesting that it may be cost-effective to subsidize transport and time costs to increase redemption rates in the lower redeeming groups such as clients – although those redeeming vouchers in this group had a higher prevalence of STIs, suggesting that a self-selection mechanism is at work.

Conclusions

Public health practitioners have to make hard choices about how to make best use of scarce resources. Interventions of high priority should be those that (a) address a public health problem that has major consequences, (b) have demonstrated effectiveness against the condition in question, and (c) are cost-effective in comparison with other uses of the money. A competitive voucher scheme has been shown to be an effective means of reaching high-risk groups and providing high quality, de-stigmatized diagnosis and treatment of STIs, and ultimately HIV prevention. Whilst the government may not always have a comparative advantage for providing these services to the hard-to-access populations (Ainsworth and Teokul 2000), this study supports the view that their being subsidized through a voucher scheme in NGO or private clinics may be a cost-effective means of HIV prevention in a low prevalence setting.

Further research is required to quantify the full extent of the impact of this type of intervention on HIV transmission, especially, as in this case, when more than one population type (sex workers, clients, transvestites) is involved. More information is also required concerning the combined impact of increased condom use and STI treatment on HIV transmission.

Endnotes

[1] Two cost-effectiveness analyses of US-based STI treatment programmes for juvenile and county jail detainees were identified (Silberstein et al. 2000; Mrus et al. 2003).

[2] One sex worker presented herself as a housewife and another as a sex worker.

[3] Competition refers to the fact that in the described programme there is competition between service providers, as opposed to programmes where the voucher is redeemable at a single service provider. Competition substantially increases the potential to produce efficiency and quality improvements in the health care services delivered. Competitive voucher schemes are one form of demand-side financing where purchasing power is given to the individuals and money follows the patient (Gorter et al. 2004a; Sandiford et al. 2004).

[4] Nicaragua has high levels of resistance of gonorrhoea for both antibiotics.

[5] Since 2003, the scheme has been scaled-up to other departments of Nicaragua and to men who have sex with men.

[6] There were different strata of sex worker, ranging from female glue-sniffers and market-based workers at the lower end of the pay scale to night-club-based at the higher end.

[7] This is based on the assumptions that all chlamydia and gonorrhoea cases attending the initial gynaecological consultation will be effectively cured by a single dose of azithromycin; and that syphilis and trichomoniasis cases are only effectively cured if they return for, and receive treatment during, the follow-up consultation.

[8] Source: [http://www.peacecorps.org/countries/nic/index.cfm], accessed on 2 July 2003.

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