Lessons for Management of Sexually Transmitted Infection Treatment Programs as Part of HIV/AIDS Prevention Strategies

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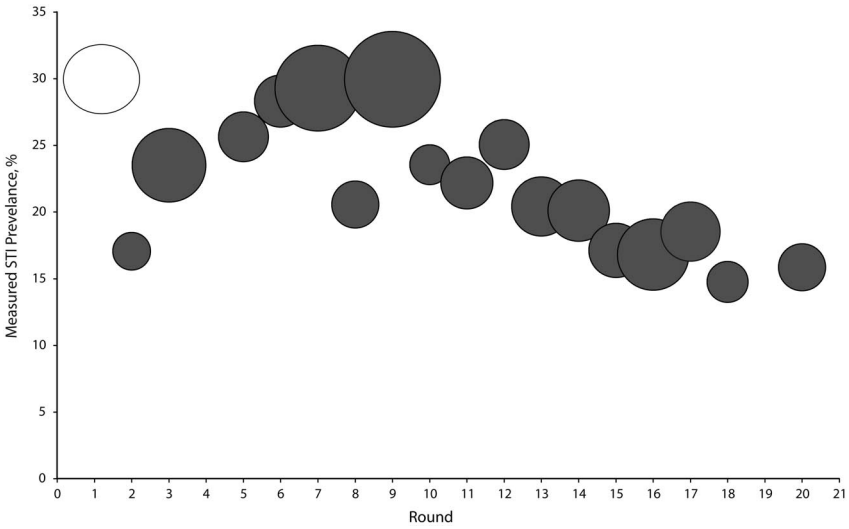
We analyzed the treatment schedule of a long-running HIV/AIDS prevention program in Managua, Nicaragua, that targets sex workers through mass and specific clinic-based treatment of sexually transmitted infections and confirmed the role of frequency of treatment in generating a sustained reduction in measured prevalence of sexually transmitted infections. Unplanned variations in the time between treatments, a situation common to public health programs, provided the basis for attributing changes in measured levels of sexually transmitted infections to the program and for testing the statistical significance of the relationship. This information is critical to program design and funding and to resource allocation. (*Am J Public Health.* 2006;96:XXX–XXX. doi:10.2105/AJPH.2005.062596)

The role of frequency of treatment in generating a sustained reduction in measured sexually transmitted infection (STI) prevalence can be confirmed by analyzing a long-running HIV/AIDS prevention program

targeting sex workers in Managua, Nicaragua. The program provides combined mass and specific clinic-based treatment of STIs.

Funding and other constraints over 9 years caused unplanned variations in the time between successive program treatments. These variations provided the data that allowed us to link the time since last treatment to change in measured STI prevalence. The analysis underpinned a decision to increase the frequency of treatment from 2 to 3 times per year. Many developing country programs display similar variations, providing data that could allow similar scrutiny. Simple models allowed us to confidently attribute prevalence outcomes to program interventions. This information can be critical to decisions relating to program design and funding and to resource allocation.



Note. The diameter of each circle is proportional to the time since commencement of the previous treatment round. STI prevalence is based on the number of sex workers with at least 1 laboratory diagnosis of *Trichomonas,* syphilis, or gonorrhea. Two rounds were omitted: one because no laboratory tests were done, and the other because of a temporary and unplanned change to testing procedures at one laboratory. The white circle represents the baseline, the first treatment round. For rounds 1 to 9, the mean number of days between rounds was 182, and from rounds 10 to 20, the mean number of days between rounds was 152. However, note that the analysis and principal inferences depend as much on the variation in the lags within each of these 2 periods as it does on the difference between the mean lags. The data split into a first half and second half format, but this need not have been true, and the same conclusions could have been drawn had the 2 means been the same.

FIGURE 1—Relation between the timing of treatment rounds and the trend in measured prevalence of sexually transmitted infections (STIs) at the commencement of each round.

METHODS

This analysis formed part of the authors' economic evaluation of a program operated by Instituto CentroAmericano de la Salud in Managua, Nicaragua. Since 1996, Instituto CentroAmericano de la Salud has distributed vouchers entitling sex workers to free-of-charge access to clinics contracted to provide care and prevention services for STI and HIV infection under strict protocols.

During each period of operation, referred to as a *round*, approximately 1150 vouchers, broadly equating to the number of "visible" sex workers in Managua, are distributed.[1] On average, 46% of the voucher recipients attend an initial consultation during which a single dose (1 g) of azithromycin is administered and samples are taken to a laboratory to diagnose STIs. At a second consultation, attended on average by 82% of the voucher "redeemers," additional treatment is provided on the basis of laboratory results and clinically diagnosed STIs.

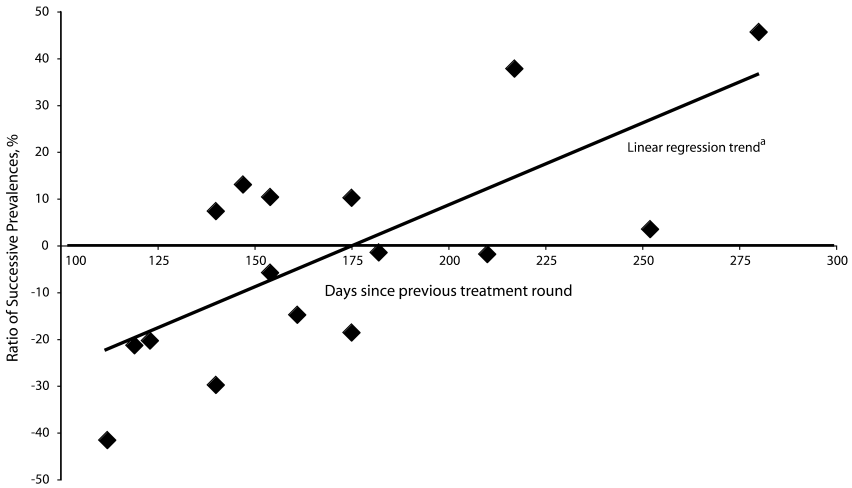
As a result, almost 40% of Managua's sex workers receive both mass and specific treatment for STIs each round. The immediate effect is the reduction in prevalence of STIs below the rate measured at the commencement of the round. Measured STI prevalence at the commencement of the subsequent treatment round indicates the rates of reinfection and new infection as sex workers enter and exit Managua's sex industry (with 40% turnover every 6 months).

The STIs treatment program also operates alongside several other programs that target sex workers but focus on changing behaviors, such as increased condom use and safer sexual practices. Because treatment of STIs and behavior modification programs work conjointly, it is difficult to determine which is more beneficial, uncertainty that is mirrored in other treatment programs. Examining the relationship between the timing of treatment rounds and the trend in measured prevalence of STIs at the commencement of each round, as shown in Figure 1, separates program effects.

RESULTS

At the commencement of round 1, approximately 29% of the sex workers redeeming vouchers had a STI. Three months later, at the commencement of round 2, the prevalence of STIs remained well below the initial rate. However, rounds 3 to 9 were characterized by varying time intervals of approximately 6 to 9 months. Prevalence of STIs at the commencement of these rounds was similar to or higher than that of round 1. It was not until the program was able to fund regular, frequent rounds (beginning with round 10) that a trend in measured prevalence of STIs was established. (The nature of the treatment was such that a reduction in average rates between rounds could be expected even when the intervals between rounds were large enough for measured rates to return to pretreatment levels.) Interweaving shorter and longer time lags between rounds was ineffective in reducing measured prevalence of STIs relative to consistent use of short to medium time lags.

A threshold level of frequency of clinic-based mass testing and mass and specific treatment may be required before systematic reductions in measured prevalence of STIs can be generated. Figure 2 shows the relationship between days since previous treatment round and change in STI prevalence. Although the associated model was specified



Note. Testing for a significant relation was based on the following simple linear model:
$\Delta S_n = \alpha + \beta D_n + \gamma T_n + \delta T_n \hat{} 2$,
where ΔS_n = % – change in STI prevalence, D_n is days since last round, and T_n is days since program inception. A quadratic form in T was included to test for a background trend independent of the program. β was of the expected sign and highly significant according to a *t* test ($P < .004$). The trend variables were individually not significant and, tested as a pair, did not even approach significance with an F test.
[a]Indicatively, <176 day frequency required to establish steady trend improvement.

FIGURE 2—Linear regression trend in commencement of successive treatment rounds to achieve a sustained reduction in measured prevalence of sexually transmitted infections (STIs).

for hypothesis testing rather than predictive purposes, it does suggest that, for this program, successive treatment rounds may need to commence within 6 months to achieve a sustained reduction in measured prevalence of STIs.

DISCUSSION

The direction of effect was expected, but the apparent strength of the relation—which was much stronger than a simple trend (evident from round 2 and showing strong statistical significance)—was striking.

Other factors that could have reduced reinfection rates with STIs include increased condom use, better targeting of condoms to higher-risk sexual encounters, increased use or greater effectiveness of non–Instituto CentroAmericano de la Salud–sponsored treatments, progressive selection bias in favor of sex workers with a disproportionate propensity to redeem vouchers multiple times, and the distribution of vouchers to clients after round 7. All these factors were analyzed, and none had the same tight, immediate match between timing of treatment rounds and change in measured rates of STIs. It is also significant that no overall upward trend was evident in either condom use or client voucher redemption that could have contributed to the downward trend in STIs among sex workers after round 10.

In the absence of such trends, recent rounds indicated the program's capacity to retain the measured prevalence of STIs at approximately 15%–50% below the rate found in round 1. Statistical testing described in Figure 2 indicated no significant explanatory power from a time trend beyond that provided by the lag between rounds. ■

About the Authors

At the time of writing, Julienne McKay was a candidate for a master's degree in international public health at the University of Sydney, Australia. David Campbell is with ACIL Tasman Pty Ltd., Sydney, Australia. Anna Cornelia Gorter is an international consultant on reproductive health issues and HIV/AIDS, Managua, Nicaragua.

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Contributors

J. McKay and D. Campbell worked closely together on developing the simulation model that formed the basis of the detailed economic evaluation of the program, from which the analysis reported in this brief emerged. J. McKay also initially assembled program data and information on complementary programs and later explored the possible effects of complementary programs with program managers. A.C. Gorter provided detailed information on the program's operations and substantial guidance and advice on the interpretation of the results of the analysis. All 3 coauthors contributed equally to the origination and preparation of this brief.

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Human Participant Protection

Use of the data was approved by the ethical review committee of the Instituto CentroAmericano de la Salud.

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