Cost-effectiveness of voluntary HIV-1 counselling and testing in reducing sexual transmission of HIV-1 in Kenya and Tanzania

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Voluntary HIV-1 counselling and testing (HIV-1 VCT).

Type of intervention
Primary prevention and screening.

Economic study type
Cost-effectiveness analysis and cost-utility analysis.

Study population
At the centre in Kenya, 50% of the study population were female and 34% were enrolled as couples. The median age was 27 years (range: 17 - 69). In Tanzania, 45% of the study population were female and 35% were enrolled as couples, with a median age of 26 years (range: 17 - 65).

Setting
The practice setting was the community. The economic evaluation took place in two centres, Nairobi, Kenya and Dar Es Salaam, Tanzania.

Dates to which data relate
Cost and effectiveness data were collected between 1995 and 1998. The price year was 1998.

Source of effectiveness data
A number of the primary outcomes were derived from a single study. Other effectiveness or epidemiological data were estimated based on the published literature.

Link between effectiveness and cost data
The costing was prospectively undertaken on the same patient sample as that used in the effectiveness study.

Study sample
The study was originally designed as a randomised controlled trial comparing HIV-1 VCT with a video-based HIV-1 health education intervention, but it was decided to use only the HIV-1 VCT data compared to no intervention, as the video health education was deemed not to be replicable. Subjects enrolled in the study were originally randomised to either branch of the trial. There were 716 participants enrolled in the intervention branch in Nairobi and 601 enrolled in Kenya, with similar numbers assigned to the comparison groups at each site. By design the study sought to enrol 50% women and 33% of clients as couples. Actual enrolment resulted in 50% women in Kenya and 45% women in...
Tanzania, and 34% of participants enrolled as couples in Kenya and 35% as couples in Tanzania. Refusal to participate and exclusion from the study were not discussed. Power calculations to determine the sample size were not reported.

**Study design**

The original study was designed as a randomised controlled trial between HIV-1 VCT with a video-based HIV-1 health education intervention, but only data from the HIV-1 VCT group were used making the study a before and after study. The study was multi-centred, with one centre in Kenya and one in Tanzania. The duration of follow-up of the treatment cohort was one year. Losses to follow-up were not reported.

**Analysis of effectiveness**

It was not stated whether the results were analysed on the basis of intention to treat or intervention completers, since losses to follow-up were not discussed. The primary health outcomes obtained from the trial were HIV-1 prevalence of index cases, sex partners of HIV-1 infected index cases, sex partners of HIV-1 uninfected index cases, condom use per sex act, condom efficacy, average number of sex acts per partner, average number of sex partners and HIV-1 infectivity adjusted for coinfection with sexually transmitted disease and for sex. These variables were then used in a model, using a probability based formula to calculate the number of HIV-1 infections averted. Effectiveness data were analysed for eight subgroups based on HIV-1 infection status, sex and enrolment in the study as an individual or as a couple.

**Effectiveness results**

HIV-1 prevalence in index cases was 0.2 (range: 0.17 - 0.23) in both Kenya and Tanzania. HIV-1 prevalence in sex partners of HIV-1 infected index cases was estimated to be the same as index cases. HIV-1 in sex partners of HIV-1 uninfected index cases was assumed to be 10% lower than index cases, and was 0.14 (range: 0.12 - 0.15) in Kenya and 0.13 (range: 0.11 - 0.15) in Tanzania. The condom use per sex act before the intervention was 19% (range: 16 - 21) in Kenya and 26% (range: 23 - 29) in Tanzania and was 83% (range: 80 - 87) in Kenya and 88% (range: 78 - 98) in Tanzania after the intervention. Condom efficacy before the intervention was 95% (range: 93 - 97) in Kenya and 90% (range: 87 - 93) in Tanzania and after the intervention was 95% (range: 93 - 98) in Kenya and 97% (range: 95 - 99) in Tanzania.

The average number of sex acts per partner per year before the intervention was 54 (range: 49 - 59) in Kenya and 54 (range: 48 - 59) in Tanzania and afterwards was 43 (range: 36 - 50) in Kenya and 36 (range: 30 - 42) in Tanzania after the intervention. The average number of sex partners before the intervention was 1.22 (range: 1.14 - 1.29) in Kenya and 1.13 (range: 1.07 - 1.20) in Tanzania and afterwards was 1.32 (range: 1.22 - 1.42) in Kenya and 1.34 (range: 1.24 - 1.44) in Tanzania after the intervention. HIV-1 infectivity was 0.0187 (range: 0.01 - 0.06) in Kenya and 0.0172 (range: 0.01 - 0.06) in Tanzania.

**Clinical conclusions**

Condom use for study participants receiving HIV-1 VCT in Kenya and Tanzania increased significantly. The average number of sexual acts per partner decreased in both countries. The average number of sexual partners increased in Kenya and Tanzania. HIV-1 VCT was effective in averting cases of HIV-1 infection.

**Modelling**

A model was used to estimate the number of HIV-1 infections averted, using the following variables: HIV-1 prevalence among sexual partners of the target population, the risk of HIV-1 transmission per act of unprotected sex (infectivity), the fraction of sex acts in which a condom was used, the effectiveness of condoms, the average number of sex acts per partner and the average number of sex partners.

**Methods used to derive estimates of effectiveness**

Further estimates of effectiveness required for the economic evaluation were life expectancy of a person aged 29 years (the mean age of the participants) in Tanzania and Kenya. This was based on available demographic data. Disease
progression parameters from HIV-1 to AIDS, and from AIDS to death were also adapted from published data.

**Estimates of effectiveness and key assumptions**
40 years was estimated for the life expectancy of a person aged 29 years in Kenya and Tanzania, 8 years for the disease progression from HIV-1 infection to AIDS and 1 year for AIDS to death.

**Measure of benefits used in the economic analysis**
The outcome measures used in the economic analysis were the number of infections averted and Disability Adjusted Life Years (DALYs) averted. Health states were valued using disability weights of 0.123 for HIV-1 infection and 0.505 for AIDS. These values were taken from a published study that used panels of health care professionals to determine disability weights using time trade off and person trade off methods. Future benefits were discounted at 3%.

**Direct costs**
Quantities and costs were not reported separately. Direct costs were calculated from estimates of the per-client quantity of goods and services used in the delivery of the intervention. Direct costs included building rent, telephone and power, training, advertising, office furniture, computers, audio-visual equipment, labour, HIV-1 test kits, laboratory fees and associated laboratory costs, other consumables (paper, office supplies etc.). The cost per client of the intervention reflected a free-standing clinic with capacity to process 3,000 clients per year. Costs were derived from cost worksheets developed for the project, project records, budgets and interviews with project staff and managers. Costs were estimated for a one-year timeframe and were discounted at 3%. The price year was 1998.

**Statistical analysis of costs**
Costs were reported with 95% confidence intervals.

**Indirect Costs**
Indirect costs were not included in the economic evaluation.

**Currency**
Tanzanian shillings and Kenyan shillings were converted to US dollars ($) using 1998 conversion rates.

**Sensitivity analysis**
Extensive multi-way sensitivity analysis was carried out on each of the model parameters. Triangular probability distribution functions were applied to each of the model values parameters for the range of values described in the article. The model was simulated using the Latin Hypercube model which generated a set of varying values of model inputs across all parameters simultaneously and associated outcomes. The dataset was then used for multivariate sensitivity analysis. Discount rates were calculated using 0% and 6%.

**Estimated benefits used in the economic analysis**
The intervention averted 1,104 cases of infection per 10,000 population in Kenya and 895 cases of infection per 10,000 population in Tanzania. The burden of disease and the number of DALYs saved were not reported.

**Cost results**
The total cost per client of the intervention in Kenya was $26.65 (range: 17.61 - 38.07) and $28.93 (range: 16.28 - 47.79) in Tanzania.
Synthesis of costs and benefits
The cost per HIV-1 infection averted due to the intervention compared to doing nothing was $249 in Kenya and $346 in Tanzania. The cost per DALY saved was $12.77 (range: 5.16 - 27.36) in Kenya and $17.78 (range: 6.58 - 45.03) in Tanzania, with costs and benefits discounted at 3%. In Kenya, the most cost-effective group to target was HIV-1 infected men presenting as part of a couple. HIV-1 VCT was also very cost-effective for HIV-1 infected men and women presenting as individuals in both countries. In Tanzania, HIV-1 VCT was also especially cost-effective for HIV-1 infected women presenting as part of a couple. Multivariate sensitivity analysis showed that the cost-effectiveness of HIV-1 was most sensitive to HIV-1 infectivity, the number of DALYs per HIV-1 infection and the cost of the intervention. With all the parameters set to be least advantageous to a cost-effective outcome, the cost per DALY saved was $27.36 in Kenya and $45.03 in Tanzania. The best case scenario shows HIV-1 VCT to cost $5.16 in Kenya and $6.58 in Tanzania per DALY saved.

Authors’ conclusions
The authors concluded that HIV-1 VCT was highly cost-effective in urban East African settings, but slightly less so than interventions such as improvement of sexually transmitted disease services and universal provision of nevirapine to pregnant women in high prevalence settings. With the targeting of VCT to populations with high HIV-1 prevalence and couples the cost-effectiveness of VCT was improved significantly.

CRD COMMENTARY - Selection of comparators
The selection of doing nothing as a comparator to the intervention was justified, as it represented current practice.

Validity of estimate of measure of benefit
The measure of benefits was based on a before and after study which presents difficulties since it is methodologically challenging to ascertain whether the changes in outcomes were due to the intervention or due to confounders. Nevertheless, it may be justified to attribute changes in behaviour to counselling. Self report bias may also have been present, since many of the primary outcomes were based on questionnaires. The authors dealt with possible bias through extensive sensitivity analyses on these parameters as well as using biological tests to confirm the validity of some of the estimates. Epidemiological parameters estimated in the literature and costs were also subjected to extensive sensitivity analysis.

Validity of estimate of costs
From the cost perspective adopted, all relevant categories of cost were included. Costs and quantities were not reported separately. A statistical analysis of costs was performed as well as an extensive sensitivity analysis.

Other issues
The authors affirmed that the intervention was generalisable to other settings, as a result of consultations with colleagues. However, they specified that care should be taken in generalising the effectiveness of VCT to other regions, cultures and rural settings.

Implications of the study
The authors concluded that political and policy support for this intervention was needed to make it available to populations currently with little access.

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