



Cost-effectiveness analysis and HIV/AIDS



UNAIDS
Technical update

August 1998

At a Glance

- Cost-effectiveness analysis is a tool which enables programme managers and planners dealing with HIV/AIDS to make informed decisions about resource allocation. By measuring and comparing the costs and consequences of various interventions, their relative efficiency can be assessed and future resource requirements estimated.
- The key problems facing programme managers and planners in cost-effectiveness analysis are:
 - inadequate data on programme costs and impact;
 - cost of information collection;
 - availability of expertise;
 - identifying and measuring suitable indicators to assess impact;
 - consideration of all consequences including direct, indirect and intangible cost savings for the provider and patient;
 - attributing impact between a number of concurrent interventions;
 - using the results of previous studies.
- Ways in which the programme managers and planners can overcome these problems are to:
 - ensure adequate information is collected on a routine basis;
 - identify and fill gaps in knowledge and ensure policy relevance of study;
 - identify and use sources of available expertise;
 - use intermediate programme outcomes as indicators of efficiency;
 - clarify the perspective of the evaluation;
 - use standardized approaches to cost-effectiveness analysis;
 - interpret results with caution.

UNAIDS *Best Practice* materials

The Joint United Nations Programme on HIV/AIDS (UNAIDS) is preparing materials on subjects of relevance to HIV infection and AIDS, the causes and consequences of the epidemic, and best practices in AIDS prevention, care and support. A *Best Practice* Collection on any one subject typically includes a short publication for journalists and community leaders (Point of View); a technical summary of the issues, challenges and solutions (Technical Update); case studies from around the world (*Best Practice* Case Studies); a set of presentation graphics; and a listing of key materials (reports, articles, books, audiovisuals, etc.) on the subject. These documents are updated as necessary.

Technical Updates and Points of View are being published in English, French, Russian and Spanish. Single copies of *Best Practice* materials are available free from UNAIDS Information Centres. To find the closest one, visit UNAIDS on the Internet (<http://www.unaids.org>), contact UNAIDS by email (unaids@unaids.org) or telephone (+41 22 791 4651), or write to the UNAIDS Information Centre, 20 Avenue Appia, 1211 Geneva 27, Switzerland.

Cost-effectiveness analysis and HIV/AIDS: UNAIDS Technical Update (UNAIDS *Best Practice* Collection: Technical Update). Geneva: UNAIDS, August 1998.

1. Acquired immunodeficiency syndrome—prevention and control
2. Cost and cost analysis

WC 503.41

Background

Why use cost-effectiveness analysis?

The cost-effectiveness analysis is an important tool in the priority-setting process of strategic planning. In responding to the HIV/AIDS epidemic the costs and consequences of the initiatives proposed in an AIDS programme must be known to the decision-makers to make best use of scarce resources. The HIV/AIDS epidemic has led to an increasing burden on already stretched health care systems. With the major burden of the disease falling on resource poor nations, the requirement for low-cost, effective interventions is paramount. Broad responses include a range of prevention and care activities. Policy-makers and planners are therefore faced with the challenge of allocating limited resources among programmes. Many factors contribute to decisions about resource allocation including concerns of sensitivity, acceptability, equity and efficiency. Cost-effectiveness analysis can be used to identify efficient strategies and methods of implementation by comparing costs and consequences of alternative activities. Cost-effectiveness analysis can provide answers to some of the most frequently asked questions, such as the following:

- Is it better to invest resources in one intervention rather than another?
- Which type or combination of services provides the best value from the budget available?
- How should resources be allocated within the competing needs of AIDS control programmes?

- How can extra investment best improve an intervention's performance?

Thus cost-effectiveness analysis can answer the question of whether a given programme is efficient and comparatively efficient; not whether an intervention is worth implementing or continuing.

What is cost-effectiveness analysis?

Cost-effectiveness analysis is one of a number of economic evaluation tools used to measure efficiency of service delivery. Here, efficiency implies that a given output is achieved at least cost or that the output is maximized at a given cost. Economic evaluation measures the costs and consequences of alternative programmes, which are then compared to assess relative levels of efficiency. There are four major techniques of economic evaluation, distinguished from each other by the method of assessment of consequences. They are as follows:

- cost analysis—costs are measured and the average or incremental cost is calculated;
- cost-effectiveness analysis—impact is measured using indicators related to the change in health status;
- cost-benefit analysis—impacts of the intervention are translated into monetary terms, in order to obtain a ratio;
- cost-utility analysis—impact is measured in terms of gains in the quality-adjusted life-years (QALYs) of an individual.

The broad framework for a cost-effectiveness analysis involves

identifying costs and consequences from a relevant perspective. The total or net costs of an intervention are divided by the health impact to obtain a ratio which indicates efficiency and is used to make comparisons. The choice of costs and consequences varies according to the perspective chosen and the intervention to be evaluated. For example, the aim of the study may be to explore changes in the methods of implementation or it could be to assess the efficiency of the introduction of a new programme. In the first case, only the extra resources and consequences involved need to be evaluated. In the latter, the full cost implications including capital investments and full consequences should be considered (see 6 in the Selected Key Materials).

Although it may not always be possible to assess the full costs and impact of the programme or intervention, some measure of cost-effectiveness or costs is always useful. These data can be used for evaluation and designing future programmes and budgets.

The Challenges

What should a cost-effectiveness analysis involve?

Cost-effectiveness analyses should be carried out within a standard framework: although analyses are context specific, a standard approach enables greater comparability between studies. Cost-effectiveness analyses should also set out to answer questions with policy relevance and fill gaps in knowledge. The analysis involves four key steps:

1. Design the study

Designing the study includes, first, defining the question that is to be answered. Next, the alternatives with which the intervention is to be compared need to be selected and described. Finally, the time horizon and the perspective the evaluation is to take are clarified. Selecting the perspective of the evaluation will affect the range of costs and consequences to be measured. The perspective of the evaluation may be that of an international donor, the government, or a local hospital. Alternatively, a societal perspective can be taken. In this, it is necessary to include costs incurred by and the impact on providers, patients and their households and communities (see 6 in the Selected Key Materials).

2. Identify and measure costs

There are three types of costs to be considered in an analysis: direct, indirect and intangible costs. Direct costs are those resource costs directly incurred by either the providers in providing care or prevention activities or by those accessing or benefiting from these services. Indirect costs are those costs

that are incurred through association with an intervention, for example, if an individual takes time off work to attend a counselling session, the associated loss in income would be an indirect cost of the intervention. Pain and anxiety are some of the intangible costs caused by an intervention. They are often associated with treatment, for example, anxiety caused by taking new treatments with unknown side-effects.

The cost of each item is measured using records or estimates that accurately reflect actual expenditure. Expenditure is then valued in economic costs (techniques for valuing economic costs are fully explained in the Selected Key Materials—see 1, 2, 5 and 6).

The key problems facing programme managers in cost measurement are often:

- inadequate programme cost data;
- costs of data collection;
- availability of the necessary expertise.

3. Identify a suitable and measurable indicator of impact

The effectiveness component of an analysis relates to the impact of the strategy. The indicator may reflect the direct, indirect and intangible consequences or a combination of these. Direct consequences are the impact of the programme on the individual and savings in treatment costs. Indirect consequences include other consequences or beneficial “side-effects” such as reduction in STD infections due to higher rates of condom use. Intangible consequences are those asso-

ciated with reduced pain and suffering. These may form an important part of the service’s aims, but are usually not quantifiable and are often presented in qualitative form. Consequences that can be measured in monetary terms can be subtracted from the costs to obtain a net cost of the programme.

A preferred measure of health impact is one that reflects, as closely as possible, the main goal of the intervention. Box 1 shows the strengths and weaknesses of a variety of outcome measures that can be used to evaluate HIV/AIDS interventions (see 7, 10, 11 and 12 in the Selected Key Materials).

• *Measuring the outcome of HIV prevention strategies*

In assessing the impact of prevention programmes, infections averted are the primary outcome. However, there are problems in measuring these. First, infections averted are best measured in a randomized, controlled trial, which can be expensive and is rarely implemented. Secondly, when estimating the impact by assessing infections averted in a target group, the secondary infections prevented i.e. infections prevented outside the target group through breaking a chain of transmission, must be considered. This will require knowledge of the epidemiology, behaviour patterns and transmission efficacy in each of the populations involved. Third, when there are a number of prevention interventions running concurrently, it can be difficult to attribute the infections averted to each one (see 3, 4, 8, 9 and 10 in the Selected Key Materials).

The Challenges

Box 1: The strengths and weaknesses of different outcome measures

| Outcome measure | Strengths | Weaknesses |
|---|--|---|
| Disability-adjusted life-years gained (DALY) —primary outcome | <ul style="list-style-type: none"> • Cross-sector, cross-programme and cross-intervention comparisons are possible • Ability to assess impact of combined clinical management and prevention strategies • Morbidity and mortality effects combined in one measure • Ability to measure consequences of clinical management when death is certain outcome • Can include indirect consequences such as TB or STD cases treated and/or prevented | <ul style="list-style-type: none"> • Based on subjective measures of disability • Possible over-simplification • Derived from and dependent on the primary outcome of the intervention • Debate over their validity • Not widely recognized outside the health sector |
| Infections averted —primary outcome of an HIV prevention strategy | <ul style="list-style-type: none"> • Comparisons across different prevention strategies are possible • DALYs can be derived easily with adequate information on mortality and life expectancy | <ul style="list-style-type: none"> • Unable to evaluate strategies that include clinical management component • Unable to compare across health interventions • Unless measured through randomized controlled trials, may need sophisticated modelling to assess impact in general population • May not include indirect consequences of intervention |
| Opportunistic infections treated and cured—primary outcome of clinical care | <ul style="list-style-type: none"> • Enables calculation of DALYs when adequate mortality data are available • Indicates success or failure of immediate treatment programme | <ul style="list-style-type: none"> • Does not measure impact on HIV disease progression • Does not measure quality of life |
| Condoms distributed or sold/numbers receiving educational material; numbers educated or counselled; cases detected through screening for blood transfusions and counselling | <ul style="list-style-type: none"> • Reflects operational efficiency of programme • Can identify most efficient method of delivery | <ul style="list-style-type: none"> • No measure of impact on HIV transmission • Does not account for variations in populations' HIV seroprevalence • Gain achieved may not reflect real change in impact |

• *Measuring the outcome of care of HIV/AIDS*

An ideal outcome measure for assessing the economic impact of care would be life-years gained or disability-adjusted life-years gained but this is rarely possible owing to the nature of the data required. If the goal of the programme is to treat a particular opportunistic infection, the number of those infections treated and cured is

an alternative primary outcome. Otherwise, an intermediate outcome combined with some qualitative assessment of the programme may be more useful and appropriate.

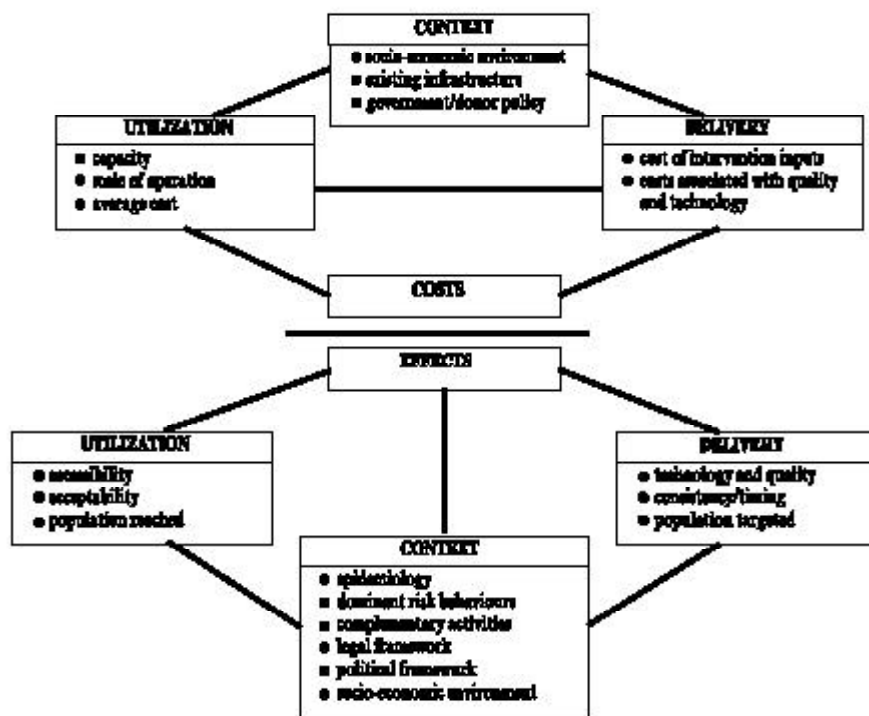
• *How can cost savings be included?*

Each episode of HIV/AIDS incurs costs in terms of treatment, care and loss in productivity. Thus, for each case of HIV prevented or improvement in efficiency of treatment can represent a cost

saving. There are direct savings that accrue to health service providers and the household due to deferred treatment and care costs. In addition, there are indirect savings through preventing or reducing the loss in productivity caused by the illness i.e. the value of the healthy years of life lost due to HIV infection. Further costs that occur as a result of HIV infection include intangibles such as pain and suffering and the derived effect

The Challenges

Figure 1
Factors that influence the costs and effects of an HIV prevention strategy



on income and suffering in an individual's household. Any reduction in these also represent a cost saving. However, they are often difficult to quantify but can be observed and included in any analysis in qualitative form (see 7, 11 and 12 in the Selected Key Materials).

The key challenges facing evaluation of consequences are:

- measuring the impact of a prevention strategy on HIV infections in the targeted and general population or ensuring adequate information is available to do so;
- identifying a suitable and measurable indicator to assess improvement in quality of life for strategies involving care;
- consideration of all consequences including direct, indirect and intangible cost savings for the provider and patient;

- attributing impact between a number of concurrent interventions;
- the time and money costs of collection of necessary information;
- availability of the necessary expertise.

4. Do sensitivity analyses on the results to test the robustness of the ratios obtained

Figure 1 presents the factors that influence the results of a cost-effectiveness analysis. Within a broader political and socio-economic context, the patient's physiological and social status, the stage of the HIV epidemic and the characteristics of the provider will all affect the efficiency of an intervention. For example, a counselling and testing programme that is aimed at rural populations will have different costs and consequences to that of an urban-based programme. As well as additional

travel costs, a more costly HIV test with faster turnaround time may be required owing to lack of central blood-storage facilities and to reduce the need for return visits. Furthermore, the smaller population, the risk behaviours and the availability or quality of post-test counselling and care will affect the numbers of infections diagnosed, the numbers coming forward for testing and hence the relative cost-effectiveness of the programmes.

This is one of many examples of why the results of cost-effectiveness analysis are rarely immediately comparable between different settings. Sensitivity analysis is the standard way of dealing with uncertainty in cost-effectiveness analysis. It can show how altering each factor will change the overall cost-effectiveness and therefore indicate the generalizability of the results. However, the context of the evaluation must always be taken into account when interpreting results and informing future programme development (see 6 and 11 in the Selected Key Materials).

The above example also illustrates how the choice of cost-effective interventions is unlikely to produce an equitable distribution of services. Thus, equity needs to be considered as a separate factor in determining resource allocation.

Important considerations when interpreting cost-effectiveness analyses are:

- use sensitivity analysis to test robustness of results;
- practise caution when applying the results;
- ensure equity is also considered.

The Responses

Identify and fill gaps in knowledge

Cost-effectiveness analysis should answer questions of policy relevance. The application of cost-effectiveness analysis tools should be used to fill gaps in knowledge to assist decision-makers in allocating resources and providing efficient services. Each analysis must consider the context within which an intervention is likely to operate to ensure its policy relevance.

Standardize approaches

Studies of cost-effectiveness should follow standard approaches to enable comparisons across different strategies. For this reason, costing guidelines for

a number of HIV prevention activities have been initiated by UNAIDS (see 2 in the Selected Key Materials). These guidelines also simplify the process of cost data collection. The standardization of consequence measurement involves clear case definition and use of common outcome measures such as DALY.

Identify sources of expertise

Expertise may not exist among programme personnel to carry out a cost analysis. In this case, economists who have previously carried out costings should be sought out and employed to provide technical support. Alternatively, extra training can be provided for accountants. The skills required for measure-

ment of the health impact will depend on the nature of the interventions in place. For the assessment of primary outcome measures, such as infections averted or DALYs gained, some level of epidemiological skills may be required.

Ensuring adequate data is available

A cost-effectiveness study should aim to collect information that can lead to the calculation of a primary outcome. Managers can improve information systems so that these data are recorded through an intervention's lifetime. On the cost side, this would involve maintaining expenditure records by activity. For consequences, keeping up patients',

Box 2: The cost-effectiveness of improved STD services for HIV prevention measured in a randomized controlled trial in Mwanza, Tanzania

A collaboration of the African Medical and Research Foundation, London School of Hygiene and Tropical Medicine and Tanzanian National Institute for Medical Research carried out a randomized controlled trial in Mwanza Region, Tanzania. The impact of improved STD services on HIV infection was assessed in the general population over two years. Cost data were collected and valued using a standard "ingredients" approach. Owing to the nature of the information available, it was possible to calculate both the cost per HIV infection averted and cost per DALY of the intervention. The results were dramatic both for the degree of positive effect and the strategy's cost-effectiveness. As a result, the improvement of STD services in Africa has become a high priority policy area.

What was so good about the study?

- Gap in knowledge identified—is improving STD services an efficient way of reducing HIV infection?
- Replicable intervention selected
- Large sample selected
- Standard ingredients approach to costing followed
- Cases averted measured by randomized controlled trial
- DALYs per infection averted and cost per DALYs calculated using a standard approach
- Sensitivity analyses performed on key variables

Source: Ref. 11 in the Selected Key Materials.

The Responses

students' or clients' records would allow easier follow up and assessment. In a societal perspective (that is, considering information on financial and intangible costs incurred and saved) it may be worthwhile to carry out occasional special studies to supplement the routine data collection.

If it is not possible to quantify an intervention's health impact, inclusion of qualitative information along with an indication of average costs or cost per intermediate outcome can help assess the potential impact.

Although the time and money costs involved in collecting and

measuring cost and effectiveness data may seem great, they should be outweighed by the consequences of carrying out the study. Even the simple collection of cost data and calculation of average costs can provide valuable information for feeding into the design of an intervention.

Box 3: A modelled cost-effectiveness analysis that can feasibly be carried out to estimate operational efficiency

This study set out to assess the cost-effectiveness of averting transfusion associated HIV infection in Zimbabwe. Using data collected from volunteers for blood donation, the cost and effects of three strategies were compared with a situation of no screening. The three options were testing alone; deferring donors on risk factors alone; and collecting and testing blood only from those who do not report a risk factor. Based on cost data from previously published studies of obtaining blood in Zimbabwe, the cost of collecting a fixed amount of uninfected blood was estimated for each scenario. It was found that the third strategy was cost-effective as identifying risk factors lessens the collection of blood during the early undetectable stages of HIV infection and reduces the number of positive units of blood that need to be discarded.

What was so good about the study?

- Policy question identified—what is the most efficient method of screening blood for transfusions?
- Perspective of blood transfusion service taken and clarified
- Baseline data taken from work site cohort
- Costs modelled on previously published research results
- Outcomes predicted using decision tree analysis
- Cost per new HIV infection averted calculated
- Sensitivity analyses performed on key variables

Source: McFarland W, Kahn JG, Katzenstein DA, Mvere D and Shamu R, "Deferral of blood donors with risk factors for HIV infection saves lives and money in Zimbabwe." *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology*. 1995; **9**(2):183–92.

Selected Key Materials

Costing methodology and cost data

General

1. Creese A and Parker D (eds) (1994). *Cost Analysis in Primary Health Care*. WHO, Geneva. Training manual for primary health care managers. A step by step guide to costing programmes and the use of cost analyses. Provides details on measuring and valuing costs, selecting and measuring consequences and applying cost analysis to estimate future costs for budgeting.

Prevention

2. Kumaranayake *et al.* (1998) *Costing Guidelines for HIV/AIDS prevention strategies*. Health Economics and Financing Programme, London School of Hygiene and Tropical Medicine. Guidelines as well as step by step guide to cost analysis, provides model costing methodologies for seven prevention strategies.

3. Soderlund N *et al.* (1993). The costs of HIV prevention strategies in developing countries. *Bulletin of WHO*; **71**(5):595–604. Article describing costing of six HIV prevention strategies in developing countries. Financial data were collected from published studies or obtained from project coordinators. Strategies covered are mass media campaigns, peer education, STD treatment, condom social marketing, safe blood provision, and needle exchange/bleach provision. Highlights the problems in measuring costs for each of the strategies.

4. Broomberg J *et al.* (1996). Economic analysis at the global level: a resource requirement

model for HIV prevention in developing countries. *Health Policy*; **38**:45–65. 20-page article estimating the global resources required for HIV prevention. The cost and affordability of a HIV prevention minimum package is assessed for each country context. The article is useful in that it identifies key variables that affect the cost of HIV prevention and describes a methodology by which to approach the estimation of the resource requirements. Thus, it shows how to identify gaps in investment and inefficiencies in resource allocation as well as providing benchmark data.

Care/clinical management

5. Scitovsky AA and Over M (1988). AIDS: cost of care in the developed and the developing world. *AIDS*; **2**(suppl 1):S71–S81. Methodology for estimating costs of medical services for people with AIDS and review of studies, to date of publication. Based on these studies, estimates of lifetime costs as well as person year costs are presented for developed and developing countries. The paper is useful for its introduction to methods of costing and highlights issues of particular relevance to AIDS clinical management.

Cost-effectiveness methodology and key studies

General

6. Panel on Cost-effectiveness in Health and Medicine (1997). *Cost-Effectiveness in Health and Medicine*. Report to the US Public Health Service. US Department of Health and Human Services, Public Health Services. A standard

reference text providing guidance on the general methodology of cost-effectiveness analysis.

7. Over M and Piot P (1995). HIV infection and sexually transmitted diseases. In Jamison D *et al.*, *Disease Control Priorities in Developing Countries*. Oxford University Press. This chapter describes the epidemiology of STDs, their public health significance in terms of burden of disease and methods, effects and cost-effectiveness of prevention and case management. HIV/AIDS is included as a particular type of STD. The burden of disease and consequences of intervention are measured in DALYs. The paper highlights the complications in assessing the primary and secondary impact of prevention programmes. It also addresses issue of prioritization in health care.

Prevention

General

8. Holtgrave DR *et al.* (1996). Economic Evaluation of HIV prevention programs. *Annual Review of Public Health*; **17**: 467–88. Literature review of economic evaluations of HIV prevention studies. The review covers cost-consequence, cost-effectiveness and cost-utility analyses. The study finds a focus of economic evaluations on the United States with the most common subjects being counselling/testing/referral/partner notification and antibody screening. The base case results of those studies that are considered most rigorous and comprehensive are presented. The review summarizes techniques used to date and identifies knowledge

Selected Key Materials

gaps in cost-effectiveness of HIV prevention studies.

Targeted prevention

9. Kahn JG (1996). The cost-effectiveness of HIV prevention targeting: how much bang for the buck? *American Journal of Public Health*; **86**(12):1709–1712. The relative cost-effectiveness of targeted interventions was modelled using nine different classifications of target populations, based on US typologies. A clear description is given of the methods behind modelling an epidemic. The study shows how cost-effectiveness analysis can be used to compare targeting of prevention strategies and the implications of a sensitivity analysis.

Screening/testing/counselling

10. Foster S and Buve A (1995). Benefits of HIV screening of blood transfusions in Zambia. *Lancet*; **346**:225–7. The financial benefits in terms of screening blood transfusions for HIV were measured for a district hospital in Zambia. The costs of the screening programme were estimated including blood collection, testing and discard costs. Useful for the description of considerations for measurement of different types of benefit i.e. the costs of screening, the infections averted, the years of life saved and the costs saved by the medical services.

Care/clinical management

11. Gilson L *et al.* Cost-effectiveness analysis of improved treatment services for sexually transmitted diseases in preventing HIV-1 infection in Mwanza Region, Tanzania. *Lancet*, 1997; **350**(27):1805–1810. This paper reports the cost-effectiveness calculations and results for the Mwanza trial (Grosskurth *et al.* 1995, Impact of improved treatment of sexually transmitted diseases on the incidence of HIV infection in rural Tanzania: a randomized controlled trial. *Lancet*; **246**:530–536). The cost-effectiveness paper sets out very clearly the methods of the study and how the calculations were made. It identifies treatment of STDs as a highly cost-effective strategy of HIV prevention.

12. Simpson KN (1995). Design and assessment of cost-effectiveness studies in AIDS populations. *Journal of Acquired Immune Deficiency Syndrome and Human Retrovirology*; **10** (suppl 4): 528–532. Short article describing specific considerations in determining cost-effectiveness of AIDS treatment and care for the chronically sick. The issues surrounding choice of outcome indicator are discussed and the key factors in data interpretation are highlighted.

© Joint United Nations Programme on HIV/AIDS 1998. All rights reserved. This publication may be freely reviewed, quoted, reproduced or translated, in part or in full, provided the source is acknowledged. It may not be sold or used in conjunction with commercial purposes without prior written approval from UNAIDS (contact: UNAIDS Information Centre, Geneva—see page 2). The views expressed in documents by named authors are solely the responsibility of those authors. The designations employed and the presentation of the material in this work do not imply the expression of any opinion whatsoever on the part of UNAIDS concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. The mention of specific companies or of certain manufacturers' products do not imply that they are endorsed or recommended by UNAIDS in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.