Recommendations from the UNAIDS Epidemiology Reference Group Meeting

Rome, October 8th-10th 2000

The UNAIDS Epidemiology Reference Group meeting was organised for UNAIDS by the UK secretariat of the epidemiology reference group (http://ceid.ox.ac.uk/unaids). Participants of the meeting are listed at the end of this document. The recommendations in this document were arrived at through discussion and review with all meeting participants. It has been written by Ties Boerma, Geoff Garnett, Simon Gregson, Nicholas Grassly and Basia Zaba, and edited by Nicholas Grassly. It aims to reflect the consensus reached by the meeting participants, though any misrepresentation of these views is the responsibility of the authors.

Oxford, November 2000

Introduction

This meeting brought together epidemiologists, demographers, public health experts and actuaries to discuss the global impact of HIV/AIDS. The principle aim of this meeting was to provide the best up-to-date advice to the Joint United Nations Programme on HIV/AIDS (UNAIDS) and the WHO as to how to estimate and project country-specific HIV prevalence and AIDS mortality. Progress on last year's meeting was reported, and recommendations developed for both the 2001 HIV prevalence estimates, and for work to be completed in time for the 2002 projections of the numbers of children whose mother and/or father will have died from AIDS. These projections play an important role in national strategic planning for HIV/AIDS control, assessment of the burden of the disease, and advocacy for effective HIV prevention strategies.

Interventions to prevent the spread of HIV and to treat AIDS patients were discussed in two contexts. Firstly, their possible impact on the future prevalence of HIV/AIDS, and how this impact can be taken into account by future country-specific projections. Secondly, the 'epidemiological' and 'structural' contextual determinants of intervention effectiveness were discussed, and the role of epidemiology and economics in prioritising interventions considered. With regard to the latter, the importance of future collaboration between the epidemiology reference group and the newly established economics group, represented at the meeting by Stefano Bertozzi, was stressed, and priorities for this collaboration set.

Following 1½ days of presentations, recommendations were developed by groups working on four topics:

1. Short-term (5-year) projections of HIV/AIDS
2. Surveillance
3. Orphanhood measurement and projection
4. The economics and epidemiology of interventions to prevent HIV spread

1. Short-term projections of HIV/AIDS

UNAIDS are interested in obtaining short-term (5-year) projections of HIV/AIDS in terms of the number of new infections by year, number of people living with HIV/AIDS and number of deaths due to AIDS for all countries. There is a need for simplicity in the procedures used to obtain these projections because of problems of costs and feasibility of data collection. However, past procedures had limitations in the light of advances in HIV surveillance and modeling, and also had problems in fitting observed trends in HIV prevalence.

The current approach of UNAIDS to estimate HIV prevalence in generalised epidemics is to fit ANC prevalence data (%) over time by eye by assuming a gamma distribution of incidence and altering 2 parameters of the gamma distribution, the start of epidemic and the shape parameter alpha. In order to obtain HIV prevalence, rather than cumulative HIV infections, AIDS mortality is assumed to remove HIV positive individuals at a specified progression rate. This rate is 9 years in countries with child mortality over 50 per 1,000 and 11 years in countries below this threshold.

Recommendations regarding changes in the progression rate are given in section 2. HIV percentage prevalence is then scaled to numbers using United Nations Population Division (UNPOP) estimates of population size over time.

Two major issues arose in discussion of how best the projections of HIV prevalence should be made:

- Rather than assuming gamma incidence (the case for Epimodel), which is simply a flexible curve for fitting data, why not use an epidemiological model, which has more easily interpretable and justifiable parameters?

- Age/sex stratified incidence is needed for projecting demographic impact and currently the short-term model does not give this. Therefore a procedure to apportion new cases amongst age classes is used by UNPOP. However, patterns of incidence by age shift with epidemic stage, so such an approach seems problematic. Should age structure be included in the models to project short-term HIV prevalence?

Epidemiological models

There was a consensus that epidemiological models would be more useful, at least in part because they are easier to justify and lend credibility to HIV/AIDS projections. Several epidemiological models for incidence were offered as alternatives to the gamma incidence function. A favoured approach was the use of a formulation described by Roy Anderson, which has just 4 parameters:

- 2 epidemiological:
  - Progression rate
  - R_0
- 2 demographic:
  - Background mortality
  - Rate of recruitment to sexually active classes

The possibility of a 5^{th} parameter, altering R_0 as a function of time to reflect interventions, was also discussed. Hania Zlotnik from UNPOP is able to make the demographic parameters available. This model was demonstrated to give prevalence curves that fit current trends in HIV prevalence in countries where the HIV epidemic has peaked and is approaching an endemic prevalence (Figure).

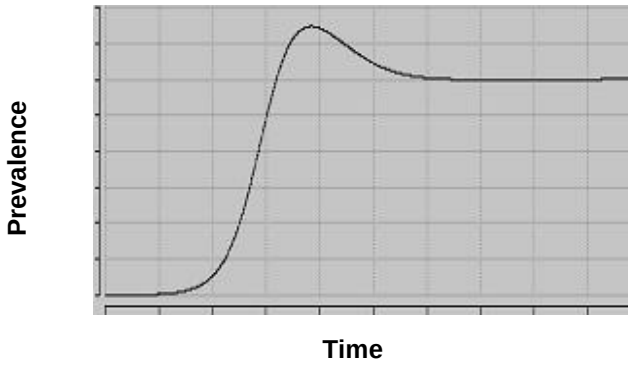

Figure: A simple epidemiological model fitting HIV prevalence data

However, further work on this model is required to explore the relationship between the rate of spread of HIV and the endemic prevalence of infection, which may necessitate the addition of a further parameter. Alternative models were considered, including one based on a simple mass action principle, presented by Griff Feeney. In this model 'barebones' the force of infection is proportional to the numbers of infected individuals, multiplied by a parameter that can change over time, reflecting the impact of interventions.

Age-structured models

Although age is an important correlate of risk behaviour and progression to AIDS, it has not been included in previous UNAIDS estimates of HIV/AIDS prevalence. This has caused problems for UNPOP estimates of the demographic impact of HIV/AIDS, which rely on simple procedures for apportioning new HIV cases to different age groups. The shifting pattern of incidence by age through the course of the epidemic was discussed, and the need for an approach that takes account of this stressed. In the short-term this means examining the output of existing epidemiological models with demographic structure. In the long-term this may mean UNPOP using an age-structured model for both projection of HIV incidence, and of numbers of AIDS deaths. The substantial additional complexity of age-structured models makes them unsuitable for use by UNAIDS in their short-term projections.

Recommendations

- **Keep using available ANC data – time series of prevalence data given as a proportion of those aged 15-49.**
- **Don't include age-structure in the model used for short-term projections**
- **UNPOP to translate non-age-structured projections into a pattern of prevalence and incidence with respect to age for projecting demographic impact**
- **Move on from the `gamma`- Epimodel - try different epidemiological functions (or set of equations) where the parameters of model have a biological/epidemiological/demographic meaning**

- **Different models should be validated using time series data of ANC data in three ways:**
    1. **Goodness-of-fit**
    2. **Predict 'future' – edit out last 5-years of ANC data, use the model to project HIV prevalence over that period and then compare**
    3. **Cross-validation of projections made by different models**
    4. **Scant and poor input ANC data should be reflected in large confidence intervals about projected prevalence (or a refusal to project based on poor data). This is aimed at preventing model misuse.**

- **Members of reference group to do the above validation work and to meet and decide on the function/set of equations to be used for the short-term projections at a meeting in Geneva just before or after Christmas.**

- **The interface developed by Tim Brown will be used to implement the chosen function/set of equations. This model adds power to the method by allowing prevalence fits for different cohorts within a country and the possibility of fitting ranges rather than point estimates of prevalence**

- **The possibility of fitting ranges of data, and also dividing data into cohorts, should be given some more consideration.**

2. Surveillance

Sentinel surveillance organisation

Antenatal clinic data will continue to be the prime source for national estimates of HIV prevalence in most countries with generalised epidemics. UNAIDS and WHO should

- continue to support the second generation surveillance initiative, and emphasise the importance of collecting data on age, parity and education. It would also be useful to collect data on the place of residence of antenatal clients, if such information does not jeopardise the anonymity of the sample
- consider other surveillance populations which may afford additional opportunities for wider surveillance, including FP clients (especially if these women are seen at the same clinics that provide ANC services)
- be aware that HIV testing of antenatal women in the context of prevention of maternal to child transmission programs may affect antenatal surveillance, and monitor the possible negative or positive effects on trends in ANC use and the effects on HIV prevalence estimates
- try to keep countries appraised of the opportunities offered by new HIV testing methods (e.g. filter paper tests) and the ethical dilemmas posed by their use

Compiling national estimates of HIV prevalence from sentinel sites

Research and surveillance data have shown that large differences in HIV prevalence and incidence may exist within urban areas, between urban areas, between urban and rural areas and within rural areas. A major problem is that relatively little is known about rural areas, as surveillance usually does not include 'truly' rural sites. While the majority of the population of many countries (especially in sub-Saharan Africa) lives in the rural areas, few live in remote rural areas. It is recommended that UNAIDS consider facilitating a systematic review of data and procedures used to obtain national estimates from site-specific ANC estimates with emphasis on urban/rural differentials. This could include support for specific studies in developing countries and organisation of meetings to:

- clarify the meaning of rural, and avoid defining as the most remote areas in a country since these will not be representative of the majority of the rural population
- discuss studies that include site information: this may include volume of antenatal clients and more detailed information on the location of facilities and typology of the area in which the clinic is located, with the aim of improving national level estimates using such information
- develop guidelines for estimation of HIV prevalence in countries that use probability proportion to size sampling of sentinel surveillance facilities, as several countries are now using this sampling strategy. A discussion document could also be prepared to consider the advantages and disadvantages of PPS sampling
- review current procedures at national level to adjust for urban/rural differentials – to date these procedures have varied from country to country and there is a need to share methods and develop guidelines, even though exact procedures may need to be adapted to local circumstances
- promote data collection in antenatal clinics that are in or nearby population-based cohort studies and review the resulting HIV prevalence estimates and the insights they afford into possible biases in ANC surveillance
- develop guidelines for national surveys that include HIV testing, and promote the inclusion of HIV testing in surveys (such as DHS) where appropriate, with the aims of obtaining more accurate national estimates for projection and trend analysis, validation and correction of ANC surveillance, and direct data on HIV prevalence in the male population

Use of ANC data to represent HIV prevalence in the general population

The relationship between HIV and fertility affects the representativeness of antenatal clinic surveillance data for women in the general population. A procedure has been developed to correct for this bias for women, assuming it is systematic, based on studies in three sub-Saharan African countries. However, there is little new evidence on the male/female ratio of HIV prevalence in the general population, and therefore no compelling reason yet exists to change current procedures which employ ante-natal prevalence as a best estimate for both sex prevalence.

- country-specific applications of the adjustment procedure should be used in settings where knowledge of prevalence in the general female population is an end in itself
- the evidence for sex differentials in prevalence should be reviewed on a country-by-country basis, and the reference group can provide inputs to this process

- the importance of contraception use in determining the relative bias of ANC data should be reviewed as new data become available and the possibility of making adjustments for low- and high-contracepting populations considered

Mortality and survival post infection

Good quality information on adult survival after HIV infection is now available from at least one developing country cohort study – the Natural History Cohort from the MRC study in Masaka, Uganda. This study has now accumulated survivorship data based on a 10 year follow-up of incident cases, classified by sex and age at infection. The study results on survivorship have fluctuated in recent years, as a limited number of deaths have occurred in the cohort. The group recommended that:

- a desk study is considered to smooth and extrapolate the survival data based on 10 years observation to represent survival (and duration specific mortality) for an 11 to 19 year post infection period. The shape of such a model curve should be based on available evidence on the survival curves from developed countries, and/or the shorter survival curves observed in Masaka for infection at older ages. A survival function which permitted a convenient parameterisation by mean or median survival time would be useful for projections for countries outside of LDCs in SSA where ART may become reasonably widespread
- a regular reporting system is put in place, whereby UNAIDS can be appraised of additional survival data from the Masaka study and similar well designed cohort studies, so that the model survival curve described above can be updated regularly to reflect trends detected in the enlarged and extended data sets as soon as they become available
- further analysis of the results of the Masaka study be considered, and that the potential effect of better health care in the Masaka study area on survival be assessed. Based on the assessment, for populations in which ART is not widely available an appropriate adult post-infection survival curve should be considered for projection purposes
- A number of studies of survival of children whose mothers are HIV infected are available. The addition of data from a rural community in the Rakai Uganda adds to our knowledge. However, more data is expected soon from the newly initiated UNICEF study, which is expected to produce preliminary findings for sub-Saharan Africa early in 2001. Options for survival curves for children should be left flexible till then. Survival curves should be fitted to the findings from the Rakai study of HIV positive child mortality and median survival time estimated. The possibility of a shorter survival time of HIV negative orphans compared to un-orphaned children should continue to be investigated. If orphan survival times are shorter this should be incorporated into procedures for estimating orphan prevalence.

Mortality measurement in the general population

Projections will need to be continuously monitored and checked against evidence of increased mortality in HIV affected populations. To ensure that high quality data are available, organisations in the UN system should encourage:

- the development of national (or sample) vital registration systems

- national censuses to continue to collect mortality information on recent household deaths, on child survival (employing specially adapted indirect methods) and on orphanhood (to obtain adult mortality estimates and direct estimates of increases in orphanhood)
- demographic surveys to collect data on recent deaths and on sibling survival to obtain adult mortality estimates, using direct and indirect analysis methods

Cohort studies

Cohort studies offer unique data collection possibilities, and more such studies are being initiated in countries with sparse data on HIV prevalence, such as India. UNAIDS should consider:

- facilitating the process of standardisation of methods and data collected in cohort studies to enable comparisons and the pooling of data on survivorship
- encouraging the research community to collect data on fertility, ANC use and contraceptive use in cohort studies (as well as other population based surveys) so that biases in antenatal clinic based surveillance can be better evaluated
- promoting the widening of the age range used in cohort studies, which should enable us to monitor HIV prevalence in men up to 60 years old
- ensuring the best ethical practice is followed

3. Orphanhood measurement and projection

Issues

The principal current issues to be addressed in this area were identified as being the following:

- Reappraisal and standardisation of the indicators of orphanhood included in the global and national HIV and AIDS surveillance reports produced by UNAIDS, UNICEF and associated organisations;

- Development of improved methods for estimating paternal and double orphans;

- Development of indicators and promotion of research on the socio-economic characteristics, well-being and vulnerability of children living in AIDS-affected households and communities.

Recommendations

National Indicators of the Impact of HIV on Orphanhood

International and other agencies currently use a wide range of different definitions of orphans and present statistics of a number of alternative indicators. There is an urgent

need to identify and promote a standard set of indicators so as to reduce the level of confusion in this area.

Until recently, global and national estimates of orphanhood have focussed on levels of maternal orphans. However, there is a widespread feeling that the death of a father can be as serious or possibly more so than that of a mother in some circumstances. Furthermore, the level of dual orphans typically rises disproportionately in populations affected by severe HIV epidemics. These children will be amongst those who suffer the most serious effects, so it is essential that estimates of levels of dual orphans be included in published reports.

Paternal and dual orphan estimates have been incorporated into some of the most recent reports but there is scope for improving upon the methods used.

- **<u>Global reports:</u> should include estimates of the current prevalence of children under 15 years old with one or both natural parents dead. These estimates should be presented both as totals numbers of cases, proportions of all children under 15 who are orphans due to AIDS, and proportions of orphans whose parents died from AIDS.**

  The necessarily restricted information on orphanhood contained in global reports is understood to be used primarily for advocacy purposes. Thus, current prevalence of the broadest form of orphans is the most useful indicator. The cut-off age of 15 is recommended because this represents the age-range within which children place the greatest demands on households and to provide some continuity with previous estimates. The proportion as well as the number of all children who are orphaned should be shown as this provides an indicator of the relative severity of the orphan burden between countries. The latter is useful and should be retained as it shows the global distribution of all orphans.

- **<u>National reports:</u> indicators should comprise estimates of current and projected orphanhood levels but not of cumulative numbers of orphans.**

  Indicators of current impact should comprise both prevalence and incidence of paternal, maternal and dual orphans and children who have lost either one or both parents, presented by 5-year age-group and for children aged 0-14 years at last birthday.

  Indicators of projected future impact should comprise prevalence and incidence of children aged less than 15 years with one or both parents dead.

  Estimates of the projected future extent of the orphanhood problem were required because of long interval between the time when HIV prevalence peaks within a population and the time when the full, accumulated impact on orphan prevalence is felt.

Estimates of incidence of orphanhood should be included as these indicate the current rate at which new children are becoming orphaned and need to be absorbed by extended family and other coping structures. Age-breakdowns of incidence can provide further useful information on the nature of the services and assistance that are needed. The HIV status of orphans should be included in reports.

Reports should cease to include statistics on cumulative numbers of children orphaned since the onset of epidemics since these were now relatively meaningless and frequently misinterpreted.

Table: Example of how orphanhood incidence could be reported.

COUNTRY - EPI FACT SHEET

age-group	maternal		paternal		both parents		either parent	
	no.	%	no.	%	no.	%	no.	%
	current incident	current incident	current incident	current incident	current incident	current incident	current incident	current incident
0-4								
5-9								
10-14								
0-14								

- **<u>Supplementary information:</u> if possible estimates of orphanhood by single year of age for children up to the age of 18 years should be made available on a web site for use by UNICEF and other parties interested in children in broader or selected age-ranges. These estimates should be derived from the same procedure and be consistent with those presented in the global and national reports.**

  Whilst it was felt that emphasis should be placed on movement towards standardisation of definitions, it was also recognised that a range of more detailed information over a broader age-range would still be needed by some specialist organisations or for particular needs (e.g.: for assessment of impact on different levels of education). Wherever possible, this information should be generated in a way that is internally consistent with that included in the more widely distributed published reports.

- **Estimates for these indicators should be a target for inclusion in the 2002 round of reports for countries with HIV prevalence levels in excess of 1 per cent and India and China**

  It is important to include India and China in view of the large overall size of their populations. Where possible, estimates for India should be state-by-state and aggregated.

Method for Estimating Paternal, Maternal and Dual Orphans

The group recommended that a new method be developed to provide separate estimates of paternal and maternal orphanhood and to infer levels of dual orphanhood.

Efforts to promote the inclusion of questions on orphanhood and sibling survival in national censuses and surveys must be intensified. It should be stressed that these are needed to improve information on current levels of orphanhood as well as for estimation of adult mortality.

Several methods for obtaining double and paternal orphanhood are in development. An outline of one proposed method was sketched out at the meeting. Separate estimates for children's probabilities of being paternal and maternal orphans would be computed by combining estimates of male and female adult mortality with estimates of male and female fertility. Estimates of dual orphans would be obtained using a predictive regression model developed using Demographic and Health Survey data. This model would be developed by identifying the key predictors of the level of dual orphanhood in populations subject to AIDS epidemics. It was envisaged that these predictors might include level of non-HIV-associated mortality, stage of HIV epidemic / level of HIV prevalence, age-difference between spouses (or possibly, level of polygyny) and age of child. Alternative methods, which do not require estimates of paternal fertility will also be considered. Such methods would be based upon corrections for concordance due to parental HIV transmission.

Adult mortality inputs to this procedure should be consistent with those presented elsewhere in the publications. Orphan mortality by HIV infection status of mother and child would be based on empirical estimates including those based on new data from longitudinal studies in Uganda, Tanzania and elsewhere. Separate calculations derived from estimates of paternal and maternal orphans would permit a degree of validation of the dual orphan estimates. Recent comparisons of indirect adult mortality estimates derived from orphanhood and sibling survival data indicate that estimates of the levels of orphanhood are reasonably reliable in a number of sub-Saharan African settings, but the problem of disappearing households should be considered. Further validation exercises of this kind could be undertaken in the future but require the inclusion of appropriate questions in national censuses and surveys.

Socio-Economic Characteristics of Orphans and Indicators of Child Vulnerability in Populations Affected by HIV Epidemics

UNAIDS should promote further research on the socio-economic characteristics, well-being and vulnerability of children living in AIDS-affected households and communities.

The impact of HIV epidemics on children is not restricted to its effects on orphans. Other children living in households with a parent or other relative who is sick, in families in which resources are over-stretched as a result of increased numbers of children for whom they are responsible, and those who live in communities severely affected by the impact of HIV and AIDS may also be vulnerable. To date, scientific research on both the nature and extent of vulnerability has been extremely limited.

Studies in this area could be based on data from ongoing data collection activities such as the DHS programme. However, longitudinal study designs are also needed to provide estimates of the age-pattern and socio-economic correlates of orphan incidence and to improve understanding of the dynamics of household composition and orphan care arrangements. Some of this work can be intiated by collaboration between the epidemiology and economics UNAIDS reference groups. A set of slides from this work would be useful for advocacy purposes.

4. The economics and epidemiology of interventions to prevent HIV spread

The focus of discussion was the prevention of HIV transmission rather than care of HIV infected patients and within this focus the evaluation of intervention strategies using theoretical tools and available data was addressed. The key discussion revolved around the relationship between the stratifications used in mathematical models and the identification of groups within the population, which would allow the dissemination of interventions however targeted. Further, the group discussed the links between the investment in intervention programmes, the efficacy and effectiveness of programmes in altering risk behaviour and the outcome in terms of HIV incidence. All three levels need to be properly understood for a complete and convincing analysis of the impact of interventions. Other topics of discussion were the usefulness of a comparative modelling exercise and the requirements of mathematical models that might prove useful teaching tools.

Recommendations

- **In developing models of interventions we need to consider how populations are characterised by driving forces and access channels. Available data should be analysed as a first step. (Long term)**

The populations that are relevant to the transmission dynamics of HIV are defined according to risk behaviours and are included in the epidemiological models that explore the targeting of interventions. However, such classifications have no meaning in terms of identifying and reaching individuals in the population with interventions. To be more useful, models of interventions should identify the relationship between risk behaviours and identifying characteristics, in order to specify more clearly how interventions could practically be distributed. An example of such a table is illustrated in Fig. 1 with the risk behaviour classification in rows and the identifying characteristics or access channels in the columns.

	Access points/channels				
Driving forces (activity groups)	Brothels bars hotspots	Miners Migrant Workers	STI clinic Clients	ANC clinic Clients	Rural house-holds
High Sex partners High sex acts High STD prev. Low circumcision IVDU					
• • •					
Low Sex partners Low sex acts Low STD prev. High circumcision IVDU					

Fig.1. An illustration table of the correlation required for understanding targeting.

- **There is a need to link together costs and effectiveness through cost functions as well as effectiveness functions. (Long term)**

As intervention coverage increases the cost per person 'reached' may change – it may go up if people become progressively harder to reach, or decrease because of economies of scale. Whilst average and marginal unit costs for different interventions are becoming available[1], there are limited examples of cost functions relating costs to scale. The relationship between potentially non-linear cost functions and the epidemiological impact of different levels of coverage of groups (similarly non-linear) is complex but needs to be addressed if the analysis of interventions is to be more realistic and relevant. Figure 2 illustrates the type of relationship possible in two of many dimensions. Whether

[1] Kumaranayake L and Watts C (2000) Economic costs of HIV/AIDS prevention activities in sub-Saharan Africa *AIDS* **14**(suppl. 3):S239-S252

a single model needs to integrate these interactions or whether it can be done in stages is not clear.

Both the costs and effectiveness of interventions depend on the context in which the intervention is carried out. The 'structural/environmental' context will cause costs to vary and determine the immediate effect of interventions on risk behaviour, antiretroviral drug uptake and adherence, etc… The 'epidemiological' context will determine how intervention effects translate into an impact on HIV incidence, and will thus determine the cost per HIV infection averted. The successful analysis and planning of interventions will therefore require a collaborative effort of analytical accountants, economists, social scientists, clinicians and epidemiologists.

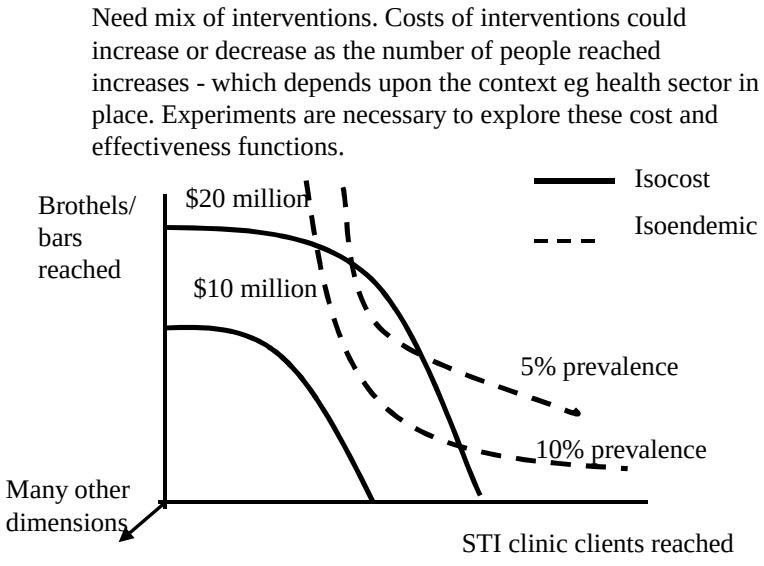

Figure 2: The potential interactions of isocost and iso-effectiveness functions

- **Qualitative comparisons of models with respect to different epidemiological settings and interventions is a useful process and should be extended, but will need to be subsidised. (Long term)**

The comparison of models is a useful exercise for exploring the appropriateness of models to different epidemiological contexts and different interventions. If most variation in results depended upon epidemiological context, this would indicate the importance of epidemiological context. If most variation depended upon modelling methods then this would indicate problems with model accuracy. While more complex and more detailed models are more realistic there is a cost in terms of developing the model, and perhaps more importantly, in understanding the model. In the development of models it is important to consider the driving forces behind the observed HIV epidemics and also the driving forces behind the model results.

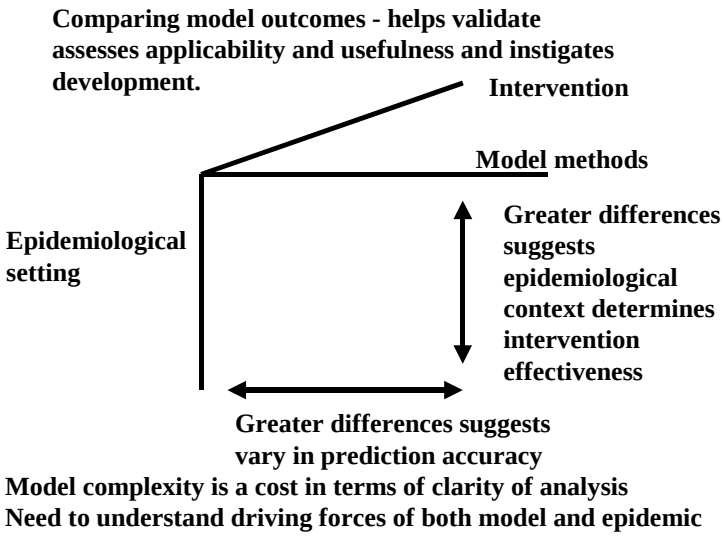

Figure 3 The diversity of study required to fully explore costs and benefits of interventions.

- **Models can be useful as teaching tools, but such tools need to be carefully crafted to prevent misuse and misinterpretation. There is a need for user training. (Long term)**

The group believed that models could be a useful, thought provoking tool, which would be more accessible through attractive and simple user interfaces. However, models for distribution need to be valid and robust. There was no consensus how best this might be achieved, but perhaps the models would want to be old because then they would be reliable and well understood. Unfortunately, this conflicts with making the models topical, relevant and interesting for current problems. Another possibility would be to limit complexity or guide the user down restricted pathways. Sensitivity analysis would be useful to illustrate some uncertainty and a range of scenarios may be useful but could give spurious confidence if an output range was viewed as a confidence bound.

Discussion

In moving forward to more accurate estimates of the extent of the HIV epidemic and understanding HIV epidemiology and control, practical decisions are essential. The competing needs of different agencies internationally and nationally, and the limited resources available, mean that priorities have to be set in deciding what methods to incorporate and when. Two measures are practical in the short term: (1) To standardise and clarify definitions to help prevent misleading and conflicting use of data. This is the major goal of the recommendations related to orphanhood; (2) To be fully informed by high quality data as it becomes available. Data on adult survival in Masaka and child survival in Rakai are examples of such data, which can be incorporated in the current estimates of patterns of AIDS associated mortality. It is likely that antiretroviral drugs

will alter the relevance of these survival curves in some locations and our ability to study survival in the absence of treatment in the future.

Other changes require a greater effort, such as the adoption of an epidemiological model for short-term projection. Because this has to be applied to aggregate data for very many countries it is appropriate that this model be kept simple. Long-term models of the demographic impact of AIDS serve a separate function and require details of the sex and age pattern of infection. In this area the goal should be a consistent translation of short-term aggregate incidence projections into age and sex stratified incidence.

When considering surveillance data, careful consideration of the biases in the sampled population should be an ongoing focus. However, comparison of antenatal clinic samples with general population samples shows that while there are biases, they are not always consistent. In particular, adjustments for fertility differentials between women by HIV status and age may need to alter according to levels of contraceptive use. Furthermore, extrapolation of ANC HIV prevalence to population prevalence is dependent on the sex ratio of infections, which varies according to setting. Therefore adopting general adjustment measures should be treated with care.

A clearer idea of what a rural sample constitutes would be valuable. A wide range of conditions or locales maybe considered rural, and the capacity to collect good information and biological samples may be hampered by poorer facilities in some remote rural sites. Resource constraints will always hamper the quality of in depth global surveillance, but over the long term the problem of how to define and study rural populations should be addressed. The development of new technologies, which facilitate simpler sample collection and HIV testing, should be considered in ongoing surveillance. At the same time, new technologies in the field of antiretroviral treatment could significantly alter the patterns of antenatal clinic use, and this will require monitoring.

The better integration of epidemiologic and economic understandings of HIV prevention and treatment will be facilitated by the establishment of an economics reference group. The possibility of more widespread and effective implementation of interventions, shown to be efficacious in clinical trials, is an important area for study, and one where the evidence base needs to be strengthened. In addition, the epidemiological and structural/environmental context of HIV epidemics should be a focus when exploring the effectiveness of interventions. This long term objective will benefit from a better understanding of past experience and the more frequent use of well designed studies.

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