

**United Nations Expert Meeting on
Software for Demographic Projections
of HIV/AIDS**

New York, 10-11 May 2005

Report of the Meeting



United Nations

Department of Economic and Social Affairs
Population Division

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DESA

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UNITED NATIONS EXPERT MEETING ON SOFTWARE FOR DEMOGRAPHIC PROJECTIONS OF HIV/AIDS

A. BACKGROUND

Responding to suggestions made by participants of the UNAIDS Reference Group meeting in Sintra, Portugal in 2004, and in preparation for the forthcoming meeting of that group in Tours, France, the Population Division of the United Nations Secretariat organized an Expert Group Meeting on Software for Demographic Projections of HIV/AIDS. The meeting was held in New York from 10-11 May 2005.

The objective of the Meeting was to evaluate, compare and improve procedures for the estimation and projection of the demographic impact of the HIV/AIDS pandemic. The meeting brought together relevant actors working on the development of software to estimate the demographic impact of HIV/AIDS: the U.S. Census Bureau, the Futures Group and staff from the Population Division (see attached List of Participants). The participants discussed demographic and epidemiological models, methods and assumptions used by the three main software packages, with the objectives to identify key areas of further improvement in order to produce consistent and comprehensive demographic estimates and projections that reflect the impact of the HIV/AIDS epidemic.

B. PRESENTATION OF THE DIFFERENT SOFTWARE APPLICATIONS

Mr. Thomas Buettner, Chief of the Estimates and Projection Section, opened the meeting and welcomed the participant. He highlighted the importance of methodological scrutiny in an area of intense public interest. He recalled the existing good cooperation between the participating institutions in the past, and he invited all participants to two days of open discussions and fruitful information exchange.

The meeting continued with a series of presentations on the major features and approaches implemented in the different software packages. First, Mr. Peter Johnson (US Bureau of the Census) made a comprehensive presentation of the software application used by the U.S. Census Bureau to incorporate the impact of the HIV/AIDS epidemic within its estimates and projections. In their new application, named RUPHivAids, the HIV/AIDS epidemic is driven by imputing incidence levels that are iterated in order to match specified or observed prevalence levels and other trends of HIV/AIDS, as supplied by UNAIDS. Internal procedures distribute events into calendar years and competing risks between background and excess AIDS mortality are taken into account. The program produces a wide range of epidemiological and demographic outputs.

Mr. John Stover (Futures Group) presented the software package SPECTRUM, which, contrary to RupHivAids, integrates the impact of the epidemic by using HIV/AIDS adult prevalence levels and given age-and sex specific distribution functions, from which incidence parameters are inferred by back calculation. Mr. Stover mentioned that one of the primary advantages of SPECTRUM is its user-friendly interface and noted that the main users make use of the program for advocacy and policy purposes.

Mr. Buettner (Population Division) made a presentation of the program used by the Population Division (AbacusDIM), which is driven by incidence levels. This demographic model was developed with the intention to stay as close as possible to the Estimation and Projection Package (EPP) and being consistent with the approaches recommended by the UNAIDS Reference Group. Contrary to the other applications, prevalence levels and trends as supplied by UNAIDS are refitted in order to allow for the inclusion of changing demographic parameters over time. To estimate the number of deaths due to AIDS by age and sex, the infected population is projected over time using a multi-state approach that takes account of the competing risks of mortality. Mr. Buettner informed the participants that the program use by the Population Division increased the recommended median survival time since infection by one year. This change to the original UNAIDS recommendation is based on the observation that the original

survival function was calculated from empirical observations that included background mortality. Finally, Mr. Buettner pointed out the importance of understanding that the uninfected may be subject to indirect effects of the epidemic (e.g. impact on the medical system) that could show in the overall levels of background mortality: Background mortality is not mortality in the absence of the epidemic.

Ms. Tammany Mulder, from the U.S. Census Bureau, then made a presentation on the results of an exercise that compared the three software applications, by using a stationary population and similar inputs (when possible). She presented the levels and trends from a series of indicators for both the No-AIDS and AIDS scenarios. In several cases, significant differences were identified between the outputs of the respective applications (e.g. total population in the No-AIDS scenario within Spectrum, high number of infected births in AbacusDIM, differences in estimated mortality levels, etc.). After careful analysis and while comparing internal default patterns integrated within the different applications, the participants were able to identify the main reasons for the observed variations. A set of suggestions and recommendations were then outlined to the interested parties with the purpose of ultimately implementing the necessary adjustments.

Further discussions were held on the following topics:

The meeting looked into the availability and quality of empirical information on background mortality and emphasized its critical importance for the estimation of the demographic impact of HIV/AIDS. It was noted that there have been signs of stagnation with respect to the progress made in the background mortality of certain countries. It could be that the health systems in some countries are collapsing due to the strain caused by the growing number of HIV/AIDS patients.

In this regard, it was observed that for many countries affected by the HIV/AIDS epidemic, reliable information on adult mortality is very scarce. For most of these countries, the Population Division relies on under-5 mortality estimates from surveys, in conjunction with selected model life tables and the implementation of the AIDS modules, to actually estimate adult mortality. Undoubtedly, there is a strong need to improve the availability of data in order to estimate adult mortality. Participants suggested alternatives sources of data to estimate adult mortality (verbal autopsies, INDEPTH data, census data with special questions that breakdown the causes of death in distinct categories, etc.).

While comparing the age specific incidence levels between the RupHivAids and AbacusDIM, it was pointed out that the levels and trends were quite different, especially for males. Overall, the age patterns of infections incorporated in the model from the Population Division appear to be too young, when compared to other models. On the other hand, the age patterns of infection as employed by the US Census Bureau seem to be too far extended into advance ages for males. Consequently, RupHivAids produced more deaths in advance ages, while AbacusDim produced substantially more deaths among young adults.

It was suggested that the younger age pattern used by the Population Division, which yields higher number of young infected females, could partially explain the higher number of infected births. Special attention, therefore, should be given to the levels encountered in the first to age groups (15-19 and 20-24), being that these have strong implications in the number of infected births within certain countries.

It was recommended that further analysis on age at first intercourse by country, using mainly DHS data, be undertaken, to obtain better insights on the age pattern of infection. The sharp rise in the incidence at very young ages could then be adjusted accordingly.

The importance of using all available prevalence level data by age and sex (e.g. data from DHS surveys and others) was emphasized. In that respect, the importance of controlling the size and design of samples from the surveys before validating the results was mentioned.

Another issue raised during the discussions was the issue of common denominators when estimating the HIV/AIDS prevalence levels. It was pointed out that the estimates from the Population Division actually refer to the population aged 15 and over. The latter is consistent with the internal working of the epidemiological model EPP used by UNAIDS. However, the final estimates produced by UNAIDS are adjusted such as to reflect the adult population aged 15-49. When matching the UNAIDS prevalence levels, estimates from the Population Division show a bias of overestimating the prevalence for the 15-49 population.

All parties reported efforts to implement internal mechanisms that imply a reduction in fertility levels due to the HIV/AIDS epidemic. All three software packages provide for a correct adjustment such that the overall fertility levels, from infected and uninfected mothers, are consistent with observed or estimated level of fertility. It was suggested that the Population Division needs to upgrade its routine so that it may also adjust fertility by age.

Also discussed was the issue of how to improve the integration of the migrant population within the epidemiological models. Currently, none of the three software packages considers migration as a potential disease vector. In the US Census Bureau program, migrants are regarded as non-infected people and are submitted to the same risk of contracting HIV/AIDS as the population of their country of destination. The Population Division's program incorporates migration, but outside the epidemiological model and thus does not explicitly model migration as part of the disease process. The Future Group's program usually excludes migration from the estimation of the demographic impact of the epidemic. The participants agreed that in most countries a more sophisticated implementation of the migrant population would probably have only limited influence on the estimation of AIDS cases or on the dynamics of the epidemic. However, it is feasible to assume that by integrating a module that would account for the migrant population that the AIDS dynamic could be quite different in countries where both migration rates and prevalence levels are relatively high.

Extensive discussions on the topic of treatment were also held during the meeting. All three parties have started incorporating special modules within their respective applications in order to take into account the impact of treatment. It was agreed that treatment should become a priority in future developments. Mr. Johnson raised the issue that anti-retroviral treatment (ART) data can be based on different definitions and circumstances. In some instances, countries report ART coverage that is actually a goal. Furthermore, there is the complex issue of evaluating who is eligible for treatment. In this regard, the issue of the onset of treatment within the modules was raised, that is, whether it should start once people have "seroconverted" to full blown AIDS or two years before. Interesting insights on how to deal differently with the treatment of children and adults were also addressed. Aside from treatment, the Population Division assumes behavioral changes in the future, which translates into lower incidence levels.

Specific interventions

For a number of countries, especially those with very high prevalence levels, the fitted prevalence curves produced by the Population Division are slightly lower than those from UNAIDS, though the prevalence levels for the year 2003 are always within the official plausibility bounds produced by UNAIDS. The main reason for this reduction in prevalence levels was to produce population age distributions that were comparable to that of recent censuses and mortality levels that are closer to different sets of estimates. In addition, within the projection phase and only for country with relatively high prevalence levels, sex ratios of infection were being gradually shifted back to 1.0, in order to avoid the collapsing of female populations and extreme differentials in projected mortality levels in favor of men. Similar adjustments are made by the U.S. Census Bureau projections for a few countries and for similar reasons.

The Population Division informed the group that it will make available country specific life tables for the background mortality, for the period 1980 to 2050.

The Population Division will also provide a set of regional migration patterns to be used by Participants.

C. CONCLUSIONS AND RECOMMENDATIONS

1) The meeting recommended to actively share information and experiences gained during the preparation of demographic estimates and projections with UNAIDS and the Reference Group. Areas of particular interest are the implications of recommended sex ratios of prevalence in the long term, prevalence levels and plausibility bounds, median survival time, etc.. Further discussion is also deemed necessary as to whether the ability to actually match the age structure of recent population censuses as well as indicators based on empirical data should serve as a basis to validate some of the underlying assumptions and inputs used in the models.

2) The UNAIDS Reference Group recommended a median survival time of 8.6 years for males and of 9.4 years for females, once infected by HIV (The UNAIDS Reference Group on Estimates, Modelling and Projections, 2002). These survival periods were obtained from cohort studies that included background mortality (Porter & Zaba, 2004). According to Porter and Zaba, results from the Kisesa cohort suggest that non-HIV-related causes account for approximately 10 per cent of the deaths of seroconverters. In order to account for the competing risks between background and AIDS mortality, the survival periods should be reconsidered in order to reflect net mortality.

3) It is suggested that the Reference Group makes recommendations on the age pattern of infection and on the median survival time once HIV has developed to full blown AIDS (for generalized and concentrated epidemics or for developing and developed countries).

4) The participants suggest that the UNAIDS mathematical epidemiological model of the HIV/AIDS epidemic (EPP) should make provisions for treatment and other interventions.

5) Modelling the HIV/AIDS epidemic in a demographic context can be implemented based on observed/modeled age patterns of prevalence or incidence. It is recommended that the Reference Group evaluates all available empirical evidence of age-specific incidence patterns that would help to improve the estimation of the demographic impact of the epidemic.

6) Aggregation of sub-national epidemics is currently done using fixed population weights. It is recommended to introduce the dynamics of the urban and rural populations, if appropriate, into the procedure whenever appropriate.

7) The participants suggested producing epidemiological parameters by groups of countries (by regional groups, development level or type of epidemic).

8) The participants recommended that its member exchange information about production cycles and important deadlines between UNPD and UNAIDS in order to better coordinate its activities.

REFERENCES

- Kholoud Porter and Basia Zaba (2004). The empirical evidence for the impact of HIV on adult mortality in the developing world: data from serological studies. *AIDS*, vol. 18 (suppl. 2) pp. S9-S17.
- UNAIDS Reference Group on Estimates, Modelling and Projections (2002). Improved methods and assumptions for estimation of the HIV/AIDS Epidemic and its Impact: Recommendations of the UNAIDS Reference Group on Estimates, Modelling and Projections. *AIDS*, vol. 16, pp. W1-W14.

9 May 2005

English only

**UNITED NATIONS EXPERT MEETING ON SOFTWARE
FOR DEMOGRAPHIC PROJECTIONS OF HIV/AIDS**

United Nations Secretariat
Department of Economic and Social Affairs
Population Division
New York, 10-11TH May 2005

ORGANIZATION OF WORK

The objective of the meeting is to improve and expand procedures for the estimation and projection of the demographic impact of the HIV/AIDS pandemic. Specifically, the group will discuss demographic and epidemiological methods and assumptions used by the three main software packages, with the objectives of comparing existing approaches and to identify key areas of further improvement in order to produce consistent and comprehensive demographic estimates and projections, while incorporating the impact of the HIV/AIDS epidemic.

Tuesday, May 10th 2005

Morning session: 9:30-12:30

- 1. OPENING OF THE MEETING:** Mr. Thomas Buettner
- 2. PRESENTATIONS OF THE DIFFERENT SOFTWARE APPLICATIONS**

NOTE: Presentations should include a discussion of the fundamental demographic, operational and epidemiologic methods used. Each presentation should be about 30 minutes, followed by a discussion of 15 minutes.

- a) Peter Johnson, United States Census Bureau
- b) John Stover, Futures Group
- c) Thomas Buettner, United Nations Population Division

Tea/coffee

Lunch break: 12:30-14:30

Afternoon Session:

14:30-17:30

3. DISCUSSION OF THE DIFFERENT SOFTWARE APPLICATIONS.

NOTE: This session will start by a brief presentation of IPC on preliminary results of comparisons of software packages, followed by a systematic comparison of approaches used to estimate the demographic impact of HIV/AIDS.

A. DISCUSSION OF APPROACHES TO DERIVE AND MODEL DEMOGRAPHIC ESTIMATES AND PROJECTIONS FOR UNINFECTED POPULATIONS

Topics included:

- Approaches for estimating and forecasting No-AIDS mortality: use of model life tables; splicing of life tables (child mortality vs. adult mortality); infant and child mortality and separation factors
- Fertility and migration for the No-AIDS scenarios

B. DISCUSSION OF MODELING AND PROJECTING HIV/AIDS INFECTED POPULATIONS, AND ESPECIALLY HIV/AIDS RELATED MORTALITY

Topics included:

- HIV incidence levels versus HIV prevalence levels (*conversion of prevalence 15-49 to 15+*)
- Sex ratio of infection and age pattern of infection by sex (variation by region, over time and by type of epidemic, that is concentrated vs. general epidemics)
- Median incubation period and median survival time once HIV has developed to full blown AIDS (variation by sex and by availability of treatment)
- Mother to child transmission (variation by region and by availability of treatment)
- Fertility and migration in the context of the HIV/AIDS epidemic

Wednesday, May 11th 2005

Morning session: 9:30-12:30

4. HANDS-ON COMPARISON AND DISCUSSION OF THE DIFFERENT SOFTWARE PACKAGES

NOTE: This session provides an opportunity to a hands-on comparison of the software packages used and the differential impact of the HIV/AIDS epidemic on key demographic indicators such as IMR, Q5, 45q15 and life expectancy at birth, the proportion of deaths by age attributed to HIV/AIDS, and others.

Tea/coffee

Lunch break:

12:30-14:30

Afternoon Session:

14:30-17:30

5. DISCUSSION ON THE IMPLEMENTATION OF TREATMENT, OTHER TOPICS

- Measures of ARV (coverage of treatment, efficiency) and their implementation into the estimation and projection procedures
- Impact of treatment options on survival (constant vs. age dependant survival)
- Possibility of establishing regional sets of epidemiological and treatment parameters

Tea/coffee

6. DISCUSSION AND CONCLUSIONS/RECOMMENDATIONS

- Summary of findings, identification of priority topics for further improvement
- Suggestions for the UNAIDS Reference Group Meeting in Tours, June, 2005

7. CLOSING OF THE MEETING

9 May 2005

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FOR DEMOGRAPHIC PROJECTIONS OF HIV/AIDS

United Nations Secretariat
Department of Economic and Social Affairs
Population Division
New York, 10-11TH May 2005

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