Quantitative Statistical Methods to Understand AIDS Epidemic

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PERSPECTIVE

Quantitative methods continue to play an important role in understanding AIDS epidemic and in evaluating therapies for HIV infected people. The primary objective is to develop statistical methods and to provide new ideas and tools for design, monitoring and analysis of HIV/AIDS studies. Like other laboratory-based outcomes, plasma HIV RNA measurements are subject to technical limitations in assays. When their values are below the assay's lower limit of detection or quantification, HIV RNA measures are censored.

Projections of AIDS incidence are critical for assessing future health care needs. There is need for more accurate forecasts for the future course of the epidemic. Projections for the future of the epidemic have most often taken the form of trying to estimate how many new AIDS cases will be diagnosed over some span of future years.

The statistical issues which arise concerning the statistics of the AIDS epidemic illustrate the impact of statistical forecasting in epidemiology. Analysis of studies of the epidemiology and natural history of infection with the HIV and subsequent onset of AIDS are mostly complicated by many statistical issues.

The issues which are essential to understanding and management of the disease have generated numerous statistical challenges are estimation of incubation period distribution, projection of the course of the epidemic, selecting proper infection density.

The HIV prevalence curves and numbers on antiretroviral therapy are used to derive national HIV incidence trends. For countries with insufficient HIV surveillance or survey data but strong vital registration and disease reporting systems, trends and levels in national HIV prevalence and incidence are matched directly to HIV case reporting and AIDS-related mortality data.

There are two factors which determine the width of the ranges around the HIV estimates. The first is the quantity and source of the HIV data available countries with more HIV surveillance data have smaller ranges than countries with less surveillance data or smaller sample sizes. Countries in which a national population-based survey has been conducted will generally have smaller ranges around estimates than countries where such surveys have not been conducted.

The second factor which determines the extent of the ranges around estimates is the number of assumptions required to arrive at the estimate – the more assumptions, the wider the uncertainty range since each assumption introduces additional uncertainties. Estimates of adult HIV prevalence are smaller than those around estimates of HIV incidence among children, which requires additional data on the probability of mother-tochild HIV transmission. The latter are based on prevalence among pregnant women, the probability of mother-to-child HIV transmission, and estimated survival times for HIV-positive children.

The estimated number of pregnant women living with HIV is not easily available in countries with concentrated epidemics. Many women living with HIV in these countries are sex workers or partners of men who have sex with men and thus are likely to have different fertility levels than the general population.

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