
STATISTICAL ANNEX

EXPLANATORY NOTES

The tables in this technical annex present new concepts and measures which lay the empirical basis for assessing health system performance. The main body of the report provides detail on the different goals for health systems and the measures of performance. Both the text of the report and the annex are based on the WHO framework for health system performance assessment.¹ The work leading to these annex tables was undertaken mostly by the WHO Global Programme on Evidence for Health Policy in collaboration with counterparts from the Regional Offices of WHO. This analytical effort was organized in eleven working groups. Membership of these working groups is listed in the Appendix. The material in these tables will be presented on an annual basis in each *World health report*. Because this is the first year of presentation for the material in Annex Tables 1 and 5-10, working papers have been prepared which provide details on the concepts, methods and results that are only briefly mentioned here. The footnotes to these technical notes include a complete listing of the detailed working papers.

As with any innovative approach, methods and data sources can be refined and improved. It is hoped that careful scrutiny and use of the results will lead to progressively better measurement of performance in the coming *World health reports*. All the main results are reported with uncertainty intervals in order to communicate to the user the plausible range of estimates for each country on each measure.

Although not provided in any table, extensive use has been made of estimates of income per capita in international dollars, average years of schooling for the population over age 15 years, percentage of the population in absolute poverty and the income Gini coefficient. In all cases, there are multiple and often conflicting sources of information from international agencies on these indicators; in addition, there are many countries for which there are no published estimates. To facilitate the analyses presented here, consistent and complete estimates of these key indicators have been developed through a variety of techniques including factor analysis, multiple imputation methods for missing data, remote sensing data from public use satellites and systematic reviews of household survey data. The details on methods and data sources for the final figures on income per capita, educational attainment, poverty and income distribution are outlined elsewhere.²

ANNEX TABLE 1

Annex Table 1 is designed as a guide for using Annex Tables 5-7, 9 and 10. Each measure of goal attainment and performance - disability-adjusted life expectancy, health equality in terms of child survival, responsiveness level, responsiveness distribution, fairness of financial contribution, performance on level of health, and overall health system performance - is reported as a league table ranked from the highest level of achievement or performance to the lowest level. Annex Table 1 lists countries alphabetically and provides the ranks on each of the measures reported in the other tables. The reader can use Annex Table 1 to identify quickly where a particular country falls in each table.

ANNEX TABLE 2

To assess the performance of health systems in terms of health achievement, it was crucial to develop the best possible assessment of the life table for each country. New life tables have been developed for all 191 Member States starting with a systematic review of all available evidence from surveys, censuses, sample registration systems, population laboratories and vital registration on levels and trends in child mortality and adult mortality. This review benefited greatly from the work undertaken on child mortality by UNICEF³ and the UN Population Division 1998 demographic assessment.⁴ To aid in demographic, cause of death and burden of disease analysis, the 191 Member States have been divided into 5 mortality strata on the basis of their level of child (5q0) and adult male mortality (45q15). The matrix defined by the six WHO Regions and the 5 mortality strata leads to 14 subregions, since not every mortality stratum is represented in every Region. These subregions are used in Tables 3 and 4 for presentation of results.

Because of increasing heterogeneity of patterns of adult and child mortality, WHO has developed a system of two-parameter logit life tables for each of the 14 subregions.⁵ This system of model life tables has been used extensively in the development of life tables for each Member State and in projecting life tables to 1999 when the most recent data available are from earlier years. Details on the data, methods and results by country of this life table analysis are available in the corresponding technical paper.⁶

A major innovation that WHO is introducing this year to demographic and other analyses is the reporting of uncertainty intervals. To capture the uncertainty due to sampling, indirect estimation technique or projection to 1999, a total of 1000 life tables have been developed for each Member State. Uncertainty bounds are reported in Annex Table 1 by giving key life table values at the 10th percentile and the 90th percentile. This uncertainty analysis was facilitated by the development of new methods and software tools.⁷ In countries with a substantial HIV epidemic, recent estimates of the level and uncertainty range of the magnitude of the HIV epidemic have been incorporated into the life table uncertainty analysis.⁸

ANNEX TABLES 3 AND 4

Causes of death for the 14 subregions and the world have been estimated based on data from national vital registration systems that capture 16.7 million deaths annually. In addition, information from sample registration systems, population laboratories and epidemiological analyses of specific conditions have been used to produce better estimates of the cause of death patterns.

Cause of death data have been carefully analysed to take into account incomplete coverage of vital registration in countries and the likely differences in cause of death patterns that would be expected in the uncovered and often poorer sub-populations. Techniques to undertake this analysis have been developed based on the global burden of disease study⁹ and further refined using a much more extensive database and more robust modelling techniques.¹⁰

Special attention has been paid to problems of misattribution or miscoding of causes of death in cardiovascular diseases, cancer, injuries and general ill-defined categories. A correction algorithm for reclassifying ill-defined cardiovascular codes has been developed.¹¹ Cancer mortality by site has been evaluated using both vital registration data and population based cancer incidence registries. The latter have been analysed using a complete age, period cohort model of cancer survival in each region.¹²

Annex Table 4 provides estimates of the burden of disease using disability-adjusted life years (DALYs) as a measure of the health gap in the world in 1999. DALYs along with disability-adjusted life expectancy are summary measures of population health.¹³ DALYs are a type of health gap that measures the difference between a population's health and a normative goal of living in full health. For a review of the development of DALYs and recent advances in the measurement of the burden of disease see Murray & Lopez.¹⁴ DALYs have been estimated based on cause of death information for each Region and regional assessments of the epidemiology of major disabling conditions.

ANNEX TABLE 5

Annex Table 5 provides measurements of health attainment in terms of the average level of population health and the distribution of population health or health equality. Two measures are reported by WHO for the first time at the country level: disability-adjusted life expectancy and the index of equality of child survival.

Achievement of the average level of population health is reported in terms of disability-adjusted life expectancy (DALE). DALE is most easily understood as the expectation of life lived in equivalent full health. As a summary measure of the burden of disability from all causes in a population, DALE has two advantages over other summary measures. The first is that it is relatively easy to explain the concept of a lifespan without disability to a non-technical audience. The second is that it is easy to calculate DALE using the Sullivan method based on age-specific information on the prevalence of non-fatal health outcomes. In the global burden of disease study, DALE was estimated at the regional level, based on the estimates of all disabling sequelae included in the study. Disability weights were measured for each of these sequelae for five standard age groups, sex and eight regions.

National estimates of DALE are based on the life tables for each Member State summarized in Annex Table 2, population representative sample surveys assessing physical and cognitive disability and general health status, and detailed information on the epidemiology of major disabling conditions in each country. Use of household surveys is complicated by the variation in self-assessed health for a given level of observed health as a function of sex, age, socioeconomic status, exposure to health services, and culture.^{15,16} The methodological details for national estimates of DALE and the uncertainty in these estimates are provided elsewhere.¹⁷

Measurement of achievement in the distribution of health is based on the WHO framework for measuring health inequality.¹⁸ The intention is ultimately to measure the distribution of health using the distribution of DALE across individuals. However, the analysis of the distribution of DALE in each country has not yet been completed. For selected countries, the distribution of life expectancy across small areas has been completed and reveals that there is often much greater variation in life expectancy and probably in DALE than expected.¹⁹ In this *World health report*, the analysis of achievement in the distribution of health, presented in Annex Table 5, is the index of equality of child survival. It is based on the distribution of child survival across countries, and takes advantage of the widely available and extensive information on complete birth histories in the demographic and health surveys and small area vital registration data on child mortality.

Statistical methods based on maximum likelihood estimation of the extended beta-binomial distribution have been developed to distinguish between variation across mothers in the number of children who have died due to chance and that due to differences in the underlying risks of death.²⁰ This statistical method has been applied to demographic and health survey data and small area data from more than 60 countries to estimate the

underlying distribution of the risk of child death.²¹ For the purposes of calculating the index of equality of child survival, child mortality distributions have been transformed into distributions of expected survival time under age 5 years. The resulting distributions of survival time have been summarized for the creation of a composite index using the following formula:

$$\text{Equality of child survival} = \left(1 - \frac{\sum_{i=1}^n \sum_{j=1}^n |x_i - x_j|^3}{2n^2 \bar{x}^{0.5}} \right)$$

where x is the survival time of a given child and \bar{x} is the mean survival time across children.

The particular form of this summary measure of inequality has been selected on the basis of a survey of preferences for measuring health inequality of over one thousand respondents.²² Because all measures of goal achievement are intended to be positive measures, the inequality index has been transformed into an index of equality by calculating one minus child survival inequality, as shown above. As the measure of inequality has a maximum value that can be greater than 1, in theory this transformed measure of equality of child survival could be negative. However, across the range of countries, no country has a degree of inequality that would lead to a measurement of equality less than zero. The value of 1 can be interpreted as complete equality and zero can be interpreted as a degree of inequality that is worse than has been seen in any country measured directly or estimated indirectly to date.

For countries without a demographic and health survey or small area data, the index of the distribution of health for child survival has been estimated using indirect techniques and information on important covariates of health inequality such as poverty, educational attainment and the level of child mortality.

ANNEX TABLE 6

The measurement of achievement in the level of responsiveness was based on a survey of nearly two thousand key informants in selected countries.²³ Key informants were asked to evaluate the performance of their health system regarding seven elements of responsiveness: dignity, autonomy and confidentiality (jointly termed respect of persons); and prompt attention, quality of basic amenities, access to social support networks during care and choice of care provider (encompassed by the term client orientation). The elements were scored from 0 to 10. Scores on each component were combined into a composite score for responsiveness based on results of the survey on preferences for health system performance assessment. For other countries, achievement in the level of responsiveness has been estimated using indirect techniques and information on important covariates of responsiveness.²⁴ To enhance the measurement of responsiveness, WHO is actively developing and field testing instruments to measure responsiveness from household respondents. This strategy of using household surveys will be supplemented with facility surveys to observe directly some components of responsiveness.²⁵

The measurement of achievement in the distribution of responsiveness reflected in Annex Table 6 is based on a very simple approach. Respondents in the key informants survey were asked to identify groups who were disadvantaged with regard to responsiveness. The number of times a particular group was identified as disadvantaged was used to calculate a key informant intensity score. Four groups had high key informant intensity scores: poor people, women, old people, and indigenous groups or racially disadvantaged groups (in most instances minorities). The key informant intensity scores for these four groups were multi-

plied by the actual percentage of the population within these vulnerable groups in a country to calculate a simple measure of responsiveness inequality ranging from 0 to 1. The total score was calculated taking into account the fact that some individuals belong to more than one disadvantaged group. Annex Table 6 provides a measure of the equality of responsiveness, scaled such that 1 is complete equality and 0 is complete inequality. For other countries, achievement on the distribution of responsiveness has been estimated using indirect techniques and information on important covariates of the distribution of responsiveness including absolute poverty and access to health care.

ANNEX TABLE 7

The index presented in this table is meant to measure both fairness of financial contribution and financial risk protection;¹ the basic concepts and principles are outlined in detail elsewhere.²⁶ The measurement of achievement in fairness of financial contribution starts with the concept of a household's contribution to the financing of the health system. The health financing contribution of a household is defined as the ratio of total household spending on health to its permanent income above subsistence. Total household spending on health includes payments towards the financing of the health system through income taxes, value-added tax, excise tax, social security contributions, private voluntary insurance, and out-of-pocket payments. Permanent income above subsistence is estimated for a household as total expenditure plus tax payments not included in total expenditure minus expenditure on food.

The distribution of households' financial contribution is calculated using household survey data which includes information on income (individual level) and household expenditure (by goods and services including health). In addition, the calculations require government tax documents (including information on income tax, sales tax, and property tax), national health accounts, national accounts, and government budgets. Such in-depth analysis has been completed for selected countries where such information is available.²⁷ For other countries, the distribution of health financing contribution has been estimated using indirect methods and information on important covariates.²⁸

To allow for comparisons of the fairness of financial contribution, the distribution of health financing contribution across households has been summarized using an index. This index is designed to weight highly households that have spent a very large share of their income beyond subsistence on health. The index therefore reflects inequality in household financial contribution but particularly reflects those households at risk of impoverishment from high levels of health expenditure. The index is of the form:

$$\text{Fairness of financial contribution} = \left(1 - 4 \frac{\sum_{i=1}^n |HFC_i - \overline{HFC}|^3}{0.125n} \right)$$

where HFC is the financial contribution of a given household and \overline{HFC} is the average financial contribution across households.

The index is designed so that complete equality of household contributions is 1 and 0 is below the largest degree of inequality observed across countries.

ANNEX TABLE 8

National health accounts are designed to be a policy relevant, comprehensive, consistent, timely and standardized instrument that traces the levels and trends of consumption of medical goods and services (the expenditure approach), the value-added created by service and manufacturing industries producing these commodities (the production approach) and the incomes generated by this process as well as the taxes, mandatory contributions, premiums and direct payments that fund the system (the financial approach). The current developmental stage of WHO national health accounts leans more towards a measurement of the financing flows.²⁹

Health care finance is divided into public and private flows. For public expenditure, the source most frequently used was Table B on expenditure by function published by the IMF in *Government finance statistics yearbook*. This rests on a body of exacting rules (not always strictly applied by the respondent countries) and deals in most cases only with central government expenditure. IMF and national sources have been used as far as possible to complement the central government data. United Nations *National accounts* (Tables 2.1 and 2.3) and consistent domestic sources have also been used. OECD *Health data* has supplied much of the information for the 29 OECD Member countries. Private expenditure on health has been estimated from United Nations and OECD *National accounts* (Tables 2.5 and 2.1, respectively) and from the ratio of medical care to total consumption as derived from household surveys, that ratio being applied to total private consumption. This concerns mainly out-of-pocket spending. Private insurance premiums, mandated employer health programmes, expenditure by non-profit institutions serving mainly households and, less frequently, private investment have been obtained from national sources. National health accounts prepared by a number of countries have been used to the extent that they were accessible. The plausibility of the estimates has been tested against financial and other analyses conducted in some countries or involving a group of countries.

A first complete table was reviewed by a large number of experts on individual countries and by policy analysts and statisticians of WHO Member States. Their observations led to a reassessment of certain sub-aggregates.

ANNEX TABLE 9

Overall health system attainment is presented in Annex Table 9. This composite measure of achievement in the level of health, the distribution of health, the level of responsiveness, the distribution of responsiveness and fairness of financial contribution has been constructed based on weights derived from the survey of over one thousand public health practitioners from over 100 countries.²² The composite is constructed on a scale from 0 to 100, the maximum value. As explained in Box 2.4, the weights on the five components are 25% level of health, 25% distribution of health, 12.5% level of responsiveness, 12.5% distribution of responsiveness and 25% fairness of financial contribution. The mean value and uncertainty intervals have been estimated for overall health system achievement using the uncertainty intervals for each of the five components.³⁰ In addition, the table provides uncertainty intervals for the ranks as well as the value of overall health system achievement. Rank uncertainty is not only a function of the uncertainty of the measurement for each country but also the uncertainty of the measurement of adjacent countries in the league table.

ANNEX TABLE 10

The index of performance on the level of health reports how efficiently health systems translate expenditure into health as measured by disability-adjusted life expectancy (DALE). Performance on the level of health is defined as the ratio between achieved levels of health and the levels of health that could be achieved by the most efficient health system. More specifically, the numerator of the ratio is the difference between observed DALE in a country and the DALE that would be observed in the absence of a functioning modern health system given the other non-health system determinants that influence health, which are represented by education. The denominator of the ratio is the difference between the maximum possible DALE that could have been achieved for the observed levels of health expenditure per capita in each country and the DALE in the absence of a functioning health system. Econometric methods have been used to estimate the maximum DALE for a given level of health expenditure and other non-health system factors using frontier production analysis. The relationship between life expectancy and human capital at the turn of the century was used to estimate the minimum DALE that would have been expected in each country (at current levels of educational attainment) in the absence of an effective health system. The details of the data, methods and results are provided elsewhere.³¹ Annex Table 10 provides uncertainty intervals for both the absolute value of performance and the rank of each country.

Overall performance of health systems was measured using a similar process relating overall health system achievement to health system expenditure. Maximum attainable composite goal achievement was estimated using a frontier production model relating overall health system achievement to health expenditure and other non-health system determinants represented by educational attainment. Results of this analysis were largely invariant to model specification. More detail is provided in the corresponding technical paper.³²

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⁴ *World population prospects: the 1998 revision*. New York, United Nations, 1999.

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⁶ Lopez AD, Salomon J, Ahmad O, Murray CJL. *Life tables for 191 countries: data, methods and results*. Geneva, World Health Organization, 2000 (GPE Discussion Paper No. 9).

⁷ Salomon J, Murray CJL. *Methods for life expectancy and disability-adjusted life expectancy uncertainty analysis*. Geneva, World Health Organization, 2000 (GPE Discussion Paper No. 10).

⁸ Salomon J, Gakidou EE, Murray CJL. *Methods for modelling the HIV/AIDS epidemic in sub-Saharan Africa*. Geneva, World Health Organization, 2000 (GPE Discussion Paper No. 3).

⁹ Murray CJL, Lopez AD, eds. *The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020*. Cambridge, MA, Harvard School of Public Health on behalf of the World Health Organization and the World Bank, 1996 (Global Burden of Disease and Injury Series, Vol. 1).

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