EDITORIAL REVIEW

The burden of HIV: insights from the Global Burden of Disease Study 2010

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Objectives: To evaluate the global and country-level burden of HIV/AIDS relative to 291 other causes of disease burden from 1980 to 2010 using the Global Burden of Disease Study 2010 (GBD 2010) as the vehicle for exploration.

Methods: HIV/AIDS burden estimates were derived elsewhere as a part of GBD 2010, a comprehensive assessment of the magnitude of 291 diseases and injuries from 1990 to 2010 for 187 countries. In GBD 2010, disability-adjusted life years (DALYs) are used as the measurement of disease burden. DALY estimates for HIV/AIDS come from UNAIDS' 2012 prevalence and mortality estimates, GBD 2010 disability weights and mortality estimates derived from quality vital registration data.

Results: Despite recent declines in global HIV/AIDS mortality, HIV/AIDS was still the fifth leading cause of global DALYs in 2010. The distribution of HIV/AIDS burden is not equal across demographics and regions. In 2010, HIV/AIDS was ranked as the leading DALY cause for ages 30–44 years in both sexes and for 21 countries that fall into four distinctive blocks: Eastern and Southern Africa, Central Africa, the Caribbean and Thailand. Although a majority of the DALYs caused by HIV/AIDS are in high-burden countries, 20% of the global HIV/AIDS burden in 2010 was in countries where HIV/AIDS did not make the top 10 leading causes of burden.

Conclusion: In the midst of a global economic recession, tracking the magnitude of the HIV/AIDS epidemic and its importance relative to other diseases and injuries is critical to effectively allocating limited resources and maintaining funding for effective HIV/AIDS interventions and treatments.

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Keywords: burden, disability-adjusted life years, Global Burden of Disease Study, global trends, HIV/AIDS, mortality

Introduction

In the last 30 years, the HIV/AIDS epidemic has emerged as one of the major challenges for the world, going from a relatively small problem in the 1980s to one of the leading causes of mortality and burden over the last decade [1–3]. The global trend is towards a larger and larger share of disease burden coming from noncommunicable diseases and injuries; however, HIV/AIDS is a dramatic exception [2–4]. Mortality and burden from HIV/AIDS increased steadily until around 2004, against the general trend of declining infectious disease burden. The HIV/AIDS epidemic has been truly global with 186 countries reporting HIV cases or deaths in 2012 [5,6].

Substantial concerted global action has emerged around the HIV/AIDS epidemic. New institutions have been formed: UNAIDS in 1996 [7] and the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) as well as the US President's Emergency Plan for AIDS Relief (PEPFAR) in 2002 [8,9]. These new global actors with substantial commitments to HIV/AIDS have been, along with many other nongovernmental programmes, key in

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raising national policy awareness in many affected countries and in scaling up access to antiretroviral therapies (ARTs) [10,11]. In 2011, eight million HIV-positive people received ARTs (a 20-fold increase since 2003), translating into 54% of all eligible people in low and middle-income countries [5]. Expansion of ART coverage is likely to have contributed to the reversal of the global trend in HIV/AIDS mortality. Successful scale-up of ARTs and the progress in reducing HIV/AIDS mortality have sparked excitement in the global community, and ambitious goals have followed [12]. In 2011, UNAIDS released its 'Getting to Zero' campaign with a vision that entails a future generation with 'zero new HIV infections, zero discrimination and zero AIDS-related deaths' [13,14].

Many factors have contributed to the achievements of the global response to the epidemic; new financial resources are likely to have been critical. Between 2002 and 2010, development assistance for health (DAH) targeted for HIV/AIDS increased from US$1.4 billion to US$6.8 billion (385.7%) [15]; and this does not include the substantial funds spent by low- and middle-income countries themselves [13]. Since 2010, however, levels of DAH have stagnated, as the long-run effects of the global financial crisis become apparent in the budgets of high-income countries. Because of the success of ART programmes and the continued evolution of the epidemic, the numbers of individuals who need ARTs will continue to rise steadily [5]. Increasing need for resources for HIV/AIDS programmes in the context of flat-line budgets is also happening in parallel with renewed attention to other health problems such as child mortality, maternal mortality and more recently noncommunicable diseases [15].

Maintaining and expanding the response to the HIV/AIDS epidemic will require continued emphasis on quantifying the magnitude of the impact of the epidemic in each country. UNAIDS and the WHO provide bi-annual assessments of the epidemic in terms of incidence of new infections, the prevalence of people living with HIV and deaths from HIV/AIDS for the vast majority of countries [5,16–18]. These analyses have been invaluable in garnering policy attention and response. The financial needs of HIV/AIDS programmes during a period of stagnant DAH levels highlight the importance of tracking the HIV/AIDS epidemic in the context of other health problems. At the national level, understanding the importance of the HIV/AIDS epidemic and its trends is facilitated by measuring the burden of disease in units that allow comparison with other major conditions. Comparable metrics of disease burden provide much-needed information on where the epidemic remains one of the dominant causes of health loss and where the burden is still rising despite progress in many countries [19].

The Global Burden of Disease Study 2010 (GBD 2010) [1–3,20–25] provides a comprehensive coherent view of the magnitude of 291 diseases and injuries from 1990 to 2010 for 187 countries. GBD 2010 uses a consistent set of definitions, approaches to data and methods to quantify health loss from all these diseases and injuries [21]. Multiple metrics are used to compare conditions, including death numbers, age-specific mortality rates, years of life lost due to premature mortality (YLLs), years lived with disability (YLDs) and disability-adjusted life years (DALYs). DALYs are a summation of YLLs and YLDs and serve as an overall metric of disease burden. In this study, we use GBD 2010 to understand the magnitude of the HIV/AIDS epidemic at the national level, in the context of all other major health problems, and how it has been changing over the last two decades.

Materials and methods

The data, efforts to improve the quality of the data and modelling strategies used in the GBD 2010 study are described in detail elsewhere [1–3,20–25]. For GBD 2010, mortality estimates were generated for 235 diseases and injuries, 187 countries, 20 age groups, both sexes and three decades (1980–2010), whereas DALY estimates were generated for 291 causes of burden, 21 regions, 20 age groups, both sexes and 3 years (1990, 2005 and 2010). In this study, we provide a synopsis of the HIV/AIDS-specific methods used in GBD 2010. To derive estimates of HIV/AIDS burden and mortality, we relied upon UNAIDS' 2012 prevalence estimates, mortality estimates derived from quality vital registration sources as well as UNAIDS' 2012 mortality estimates, and GBD 2010 disability weights (DWs). HIV/AIDS DALY estimates are presented here for the first time for 187 countries.

We collaborated with UNAIDS to derive our cause-specific mortality estimates. This collaboration resulted in the use of a hybrid modelling method that selected mortality estimates from either the Cause of Death Ensemble model (CODEm) or UNAIDS 2012 revision estimates on a country-by-country basis [1]. CODEm, which was designed to develop ensembles of best-performing models, is the cause of death modelling approach that was used for a majority of the diseases and injuries in GBD 2010 (see Foreman *et al.* [26] for more detail.) For 33 countries with complete and high-quality vital registration systems, we used CODEm (Table 1). For

Table 1. Countries with high-quality vital registration systems.

Antigua and Barbuda	Dominica	Norway
Argentina	France	Portugal
Australia	Germany	Saint Lucia
Austria	Grenada	Saint Vincent and the Grenadines
Barbados	Ireland	Singapore
Belgium	Italy	Spain
Canada	Japan	Sweden
Chile	Luxembourg	Switzerland
Costa Rica	Malta	United Kingdom
Cuba	Netherlands	United States
Denmark	New Zealand	Uruguay

the remaining countries, cause of death data are not sufficient for analysis because either there are few deaths recorded or there is a systematic misclassification of deaths in vital registration or verbal autopsy studies. For these countries, estimates of HIV/AIDS mortality with uncertainty by age and sex were provided directly by UNAIDS from their 2012 revisions in May 2011. For Thailand and Panama, the UNAIDS 2012 estimates we received were dramatically higher than UNAIDS' 2010 estimates and were inconsistent with our all-cause mortality evidence; for these two countries, we used UNAIDS' 2010 revision estimates. Uncertainty in cause of death model predictions has been captured using standard simulation methods by taking 1000 draws for each age, sex, country, year and cause [1,27].

A key part of the GBD 2010 cause of death estimation strategy is to enforce consistency between the sum of cause-specific mortality and independently assessed levels of all-cause mortality derived from demographic sources for every age-sex-country-year group (see Wang *et al.* [22] for details on the all-cause mortality analysis.) Uncertainty in every GBD 2010 cause of death model outcome had to be taken into account because some causes are known with much greater precision than others. To enforce consistency, we used a simple algorithm called CoDCorrect; at the level of each draw from the posterior distribution of each cause, we proportionately rescaled every cause such that the sum of the cause-specific estimates equaled the number of deaths from all causes (see Lozano *et al.* [1] for more details on CoDCorrect.) Estimates of HIV/AIDS mortality in a given country were proportionally adjusted less than other causes except where estimated HIV mortality in an age-sex group was greater than all-cause mortality, as there is less uncertainty surrounding the initial estimates (provided in large part by UNAIDS) than most other causes.

To calculate DALYs attributable to HIV/AIDS, HIV/AIDS-specific YLLs and YLDs were computed and then summed together. YLLs are computed by multiplying the number of deaths at each age x by a standard life expectancy at age x [28], and YLDs are the product of prevalence times the DW for a particular disease sequelae [3]. DWs are scaled from 0 to 1 and represent the severity of health loss associated with that health state. A value of 0 implies that a health state is equivalent to full health, and a value of 1 implies that a state is equivalent to death (see Salomon *et al.* [23] for more detail). In GBD 2010, HIV/AIDS has five unique YLD sequelae, each with their own DW. The HIV/AIDS-specific disease sequelae are HIV disease resulting in mycobacterial infection (DW of 0.399), HIV pre-AIDS asymptomatic (DW of 0.051), HIV pre-AIDS symptomatic (DW of 0.221), AIDS with antiretrovirals (DW of 0.053) and AIDS without antiretrovirals (DW of 0.547) [23]. UNAIDS 2012 prevalence estimates were used to calculate HIV/AIDS-specific YLDs and these were disaggregated into the various HIV/AIDS sequelae using the fraction of tuberculosis (TB)-HIV reported in WHO TB case notifications, data on antiretroviral coverage from PEPFAR, GFATM and UNAIDS, and UNAIDS CD4 cell count data [29].

In GBD 2010, uncertainty in DALYs by cause reflects uncertainty in YLLs and YLDs [2]. Uncertainty for HIV/AIDS-specific YLLs encompasses uncertainty in the levels of all-cause mortality in each age-sex-country-year [22] as well as uncertainty in the HIV/AIDS mortality estimation for that age-sex-country-year [1], whereas uncertainty for HIV/AIDS-specific YLDs comes from the uncertainty surrounding the 2012 revision prevalence estimates provided directly by UNAIDS. Comorbidity is taken into account in the GBD 2010 by using all prevalence data and running a microsimulation for each country age and sex group [3]. Within each country for each time period, leading causes of DALYs have been computed and ranked. Ranks are calculated at the draw level and means are taken from these ranks. Mean ranks for all causes are compiled and sorted and then rank integer values are assigned.

Results

Figure 1 shows the evolution of global deaths from the HIV/AIDS epidemic from 1980 to 2010. Over this period, deaths increased dramatically until peaking in 2006; the annual rate of increase in global mortality from 1980 to 2006 was 19.4%. Since 2006, global HIV/AIDS mortality has steadily declined at an average annual rate of 4.17%. The decline in HIV/AIDS mortality reflects both declining incidence in some settings and the impact of the rapid scale-up of ART in some countries with large epidemics [30]. This figure does not put the magnitude of the HIV/AIDS epidemic in context. Figure 2 shows the leading causes of disease burden measured using DALYs in 1990 and 2010. HIV/AIDS was the 33rd most important cause of burden in 1990 and has increased dramatically to the fifth leading cause of disease burden in 2010. In absolute terms, the burden of HIV/AIDS increased during that period by 354%. To add further context, from 1990 to 2010, global YLDs from HIV/AIDS increased by 109.4%, compared with a 2.5% increase in YLDs from all causes [3], while global age-standardized mortality from HIV/AIDS increased by 258.4%, compared with a 21.5% decline in global age-standardized all-cause mortality during this same period [1,22]. In 2010, HIV accounted for 2.8% of global deaths and 3.3% of global DALYs. Despite the recent declines in global HIV/AIDS mortality, today, HIV/AIDS remains one of the leading global causes of both mortality and burden.

HIV/AIDS and road injuries are the only top 10 causes of burden that are concentrated in young adults. Due to the

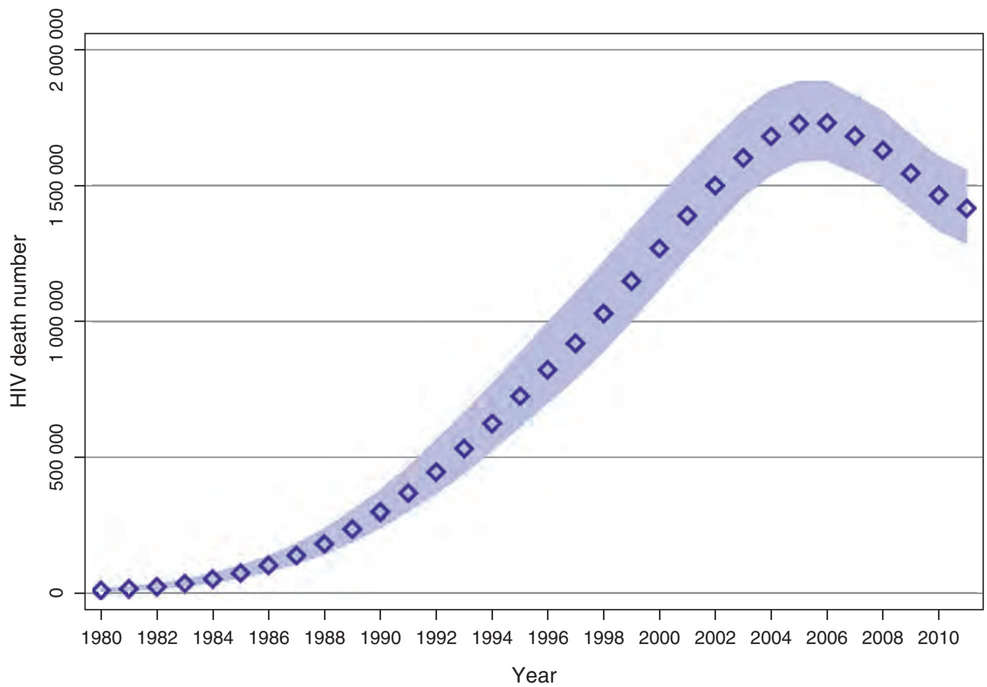

Fig. 1. Global HIV/AIDS mortality, 1980–2010. This illustration shows global HIV/AIDS mortality over time with 95% confidence intervals.

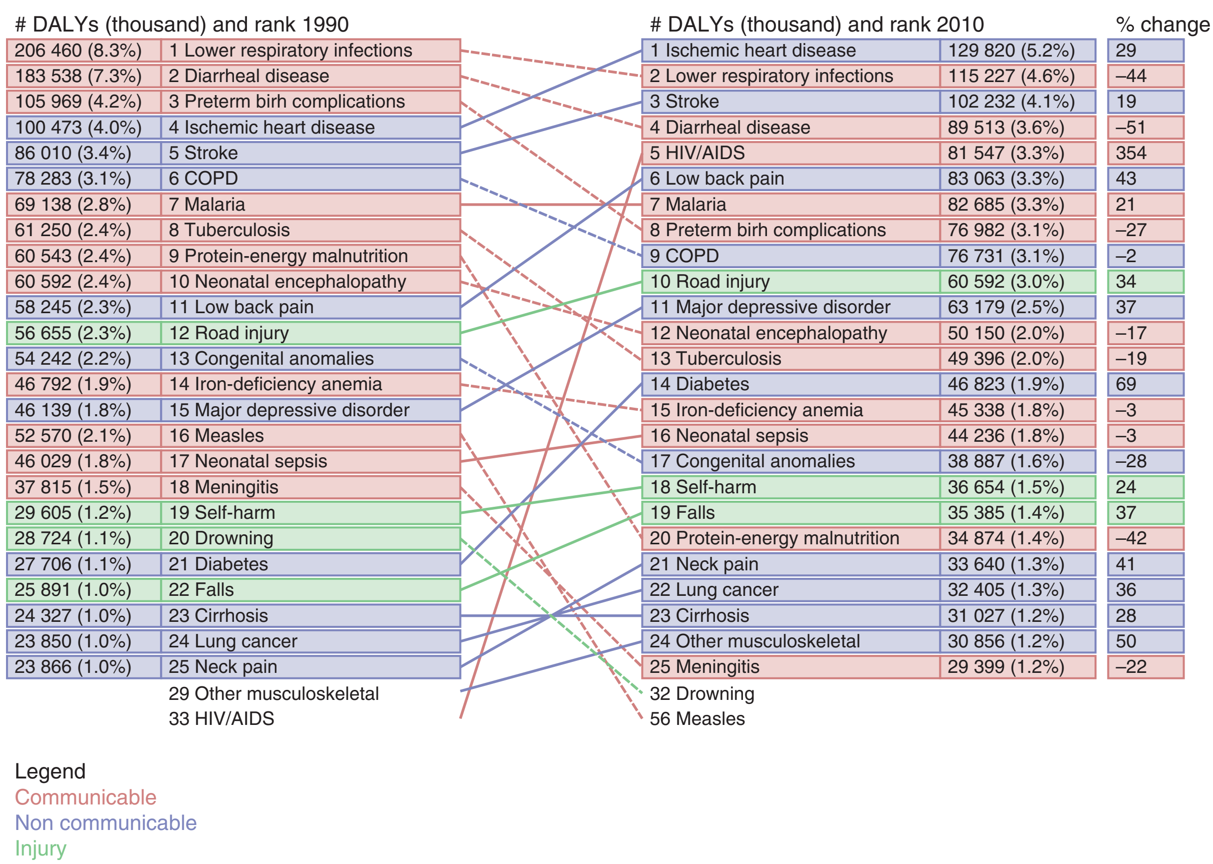

Fig. 2. Global ranks for top 25 causes of disability-adjusted life years, 1990–2010. Causes that are communicable, maternal, neonatal or nutritional deficiencies are shown in red, noncommunicable causes are in blue and injuries are in green. Number of global DALYs and the percentage of global DALYs attributable to each cause are included. Percentage change in DALYs from 1990 to 2010 by cause is also included on the right-hand side.

nature of HIV/AIDS transmission and the timing of sexual contact, most of the burden of HIV/AIDS is in young adults. In fact, HIV/AIDS is the number one cause of burden for men in age groups 30–34, 35–39 and 40–44 years, and for women from ages 25–44 years (Fig. 3). In children under the age of 5 years, HIV/AIDS ranks as the 11th cause of burden for both men and women (Fig. 3). At older ages, HIV/AIDS is not a leading cause of disease burden. In countries of the world with large epidemics, such as in Eastern and Southern Africa, the concentration of HIV/AIDS in young adult age groups makes the disease an overwhelming health problem. For example, in South Africa in 2010, 75% of deaths in the 30–34 age group are from HIV/AIDS; in women, this percentage goes up to 84%. In the same age group, there are 78 countries where HIV/AIDS accounts for more than 10% of all deaths. As a majority of the HIV/AIDS burden is concentrated in these younger age groups, DALYs attributable to the disease are dominated by premature mortality; in 2010, YLLs contributed to 94.7% of global HIV/AIDS DALYs.

Global HIV/AIDS statistics mask the extraordinary epidemic burden in selected countries. In 2010, HIV/AIDS was ranked as the leading cause of DALYs in 21 countries shown in red in Fig. 4 and the second leading cause of DALYs in an additional seven countries. The countries where HIV/AIDS ranks as number one fall into four distinctive blocks: the countries in Eastern and Southern sub-Saharan Africa spanning from Kenya and Uganda in the east to Namibia and South Africa in the south; a second smaller set of countries in central sub-Saharan Africa including Equatorial Guinea, Gabon and Congo, where HIV/AIDS epidemics are smaller, but still the leading cause of burden; the third block is made up of Thailand alone, where HIV/AIDS is the leading cause of burden in that country; and the final set of countries is in the Caribbean, including Bahamas, Jamaica and Suriname. Although HIV/AIDS may be a leading cause of DALYs in 21 countries, it is a much bigger problem for some countries than others. For example, in South Africa and Suriname, two countries where HIV/AIDS is the leading cause of DALYs, HIV/AIDS contributed to 39.94% of total DALYs in South Africa in 2010 and only 8.46% of total DALYs in Suriname. In 26 other countries, HIV/AIDS is among the top five causes of burden but not the leading cause. These include Colombia, Guyana, Myanmar, Russia, Ukraine and a number of countries in sub-Saharan Africa. In some countries, such as India, HIV/AIDS is not a top 10 cause of burden (it ranks 15th) but still represents a substantial percentage of the global HIV/AIDS burden (11.4%). Table 2 shows the number of DALYs due to HIV/AIDS for each country, the percentage of disease burden and mortality in each country attributable to the epidemic, the percentage of the global HIV/AIDS burden present in that country, the percentage decline from peak HIV/AIDS mortality to present and the rank of HIV/AIDS compared with other leading burden causes at the country level.

Although HIV/AIDS is a global epidemic, a majority of the disease burden is concentrated in a handful of

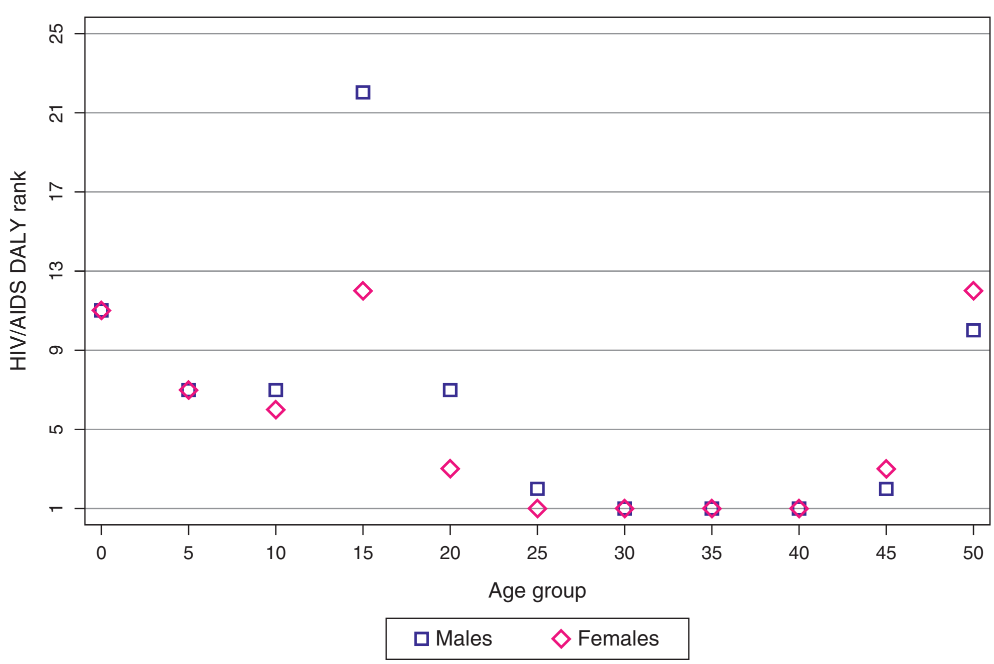

Fig. 3. Global HIV/AIDS disability-adjusted life year rank by age and sex, 2010. This figure illustrates where HIV/AIDS ranks among other leading causes of global burden by age and sex. Five-year age groups are represented in this graph. Blue squares indicate men and pink diamonds indicate women.

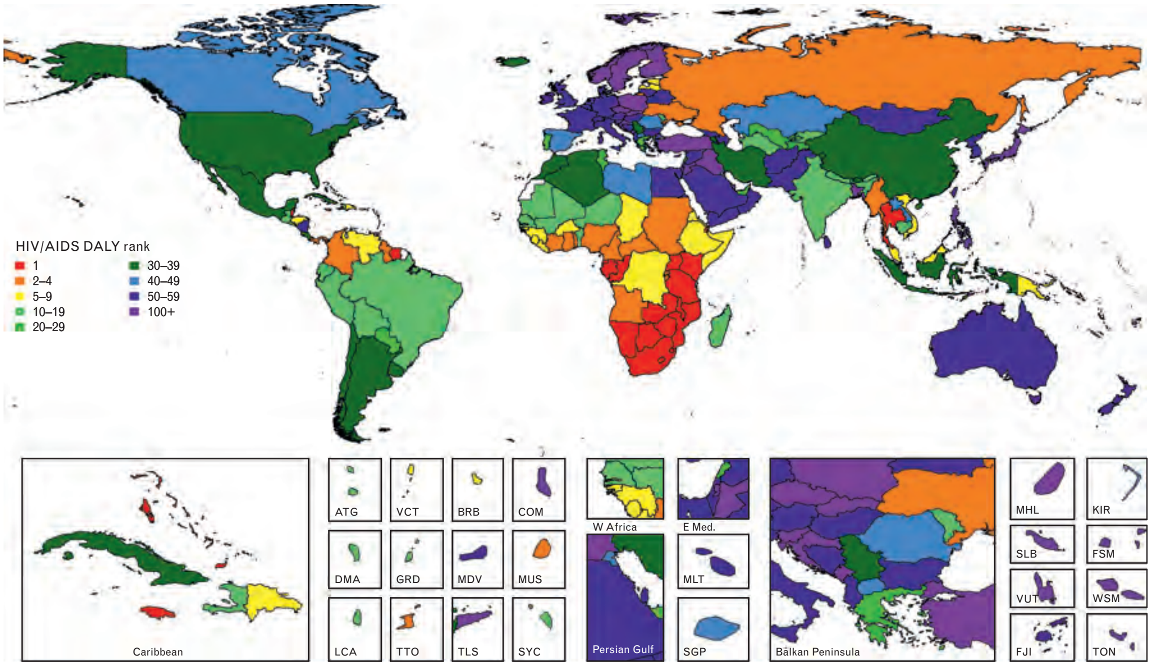

Fig. 4. HIV/AIDS disability-adjusted life year rank by country, 2010. Colours correspond to bins of HIV/AIDS disease burden rank. Red indicates countries where HIV/AIDS is the leading cause of burden.

countries with particularly large epidemics. When evaluating the percentage of global HIV/AIDS DALYs by rank in 2010, the summation of HIV/AIDS DALYs for countries where HIV/AIDS is the leading cause or in the top five leading causes of burden accounts for 44.6 and 75.2% of global HIV/AIDS DALYs, respectively (Fig. 5). Sub-Saharan African countries, in particular, dominate the proportion of global HIV/AIDS DALYs; in 2010, the 47 countries in this region contributed to 70.9% of global DALYs attributable to HIV/AIDS. Compared with the peak in global HIV/AIDS burden around 2005, the fraction of global burden attributable to HIV/AIDS in countries where HIV/AIDS ranks as a leading cause has decreased. In 2005, 80.3% of the global epidemic burden compared with 75.2% in 2010 was in countries where HIV/AIDS ranked in the top five leading causes of disease burden. These percentages illustrate the recent shift in the burden of HIV/AIDS at the country level. Burden attributable to HIV/AIDS is decreasing in high-burden countries and shifting to affect a greater number of countries that have not historically had large epidemics and are struggling with other leading causes of burden. In 2010, for example, 20.0% of the HIV/AIDS burden was in countries where HIV/AIDS ranked higher than 10 compared with only 15.5% in 2005 (Fig. 5). Furthermore, although global HIV/AIDS mortality has been steadily decreasing since 2006, it has actually been on the rise for 98 countries during this same period (Table 2).

The rank of HIV/AIDS among the leading causes of DALYs has generally increased over time to reflect the epidemic's progression; however, the change in the rank of HIV/AIDS DALYs has been more pronounced in some regions than others. In 1990, HIV/AIDS ranked as the third leading cause of DALYs in Southern sub-Saharan Africa, but did not even make the top 100 leading DALY causes in South Asia where it ranked 122nd (Fig. 6a, b). From 1990 to 2010, HIV/AIDS increased in the ranks of leading DALY causes for both of these regions and for other regions across the globe. The rate of increase in rank and relative HIV/AIDS burden impact, however, is again variable by region. In 2010, HIV/AIDS became the leading cause of DALYs in southern sub-Saharan Africa (having increased 1065% since 1990) but only ranked as the 17th leading burden cause in South Asia. Although the burden rank for HIV/AIDS may be lower in South Asia, the percentage change from 1990 to 2010 is nearly five-fold greater than the percentage change in southern sub-Saharan Africa during this period (4761% change for South Asia). The number of DALYs in southern sub-Saharan Africa compared with South Asia in 2010, however, is 1.63 times greater.

Discussion

From 1990 to 2006, the burden of HIV/AIDS increased dramatically at the global level. Likely due to a combination of declines in incidence, massive scale-up of ART coverage [5,30,31] and rising coverage of PMTCT [32], the burden of HIV/AIDS has declined in the last half decade. Along with a few other interventions,

Table 2. HIV/AIDS disability-adjusted life years and other HIV/AIDS burden metrics by country for 2010 with 95% confidence intervals.

Country[a]	HIV/AIDS DALY number (in thousands)	% of total DALYs attributable to HIV/AIDS	% of deaths attributable to HIV/AIDS	% of global HIV/AIDS deaths	% change of deaths from peak to present	HIV/AIDS DALY rank
South Africa	11 915.619 (11 213.482, 12 639.352)	40.0% (37.7%, 42.1%)	41.1% (38.6%, 43.5%)	14.6% (13.7%, 15.6%)	−32.9% (−34.7%, −30.6%)	1
India	9265.130 (7200.253, 11 080.598)	1.8% (1.4%, 2.1%)	1.8% (1.4%, 2.2%)	11.4% (9.0%, 13.5%)	−8.7% (−13.6%, −3.5%)	15
Nigeria	9011.595 (8169.121, 9962.661)	7.4% (6.4%, 8.6%)	9.2% (8.0%, 10.7%)	11.1% (10.4%, 11.8%)	−14.2% (−20.8%, −8.1%)	2
Tanzania, United Republic of	4674.416 (4277.838, 5073.069)	17.3% (15.4%, 19.2%)	21.2% (18.8%, 23.5%)	5.7% (5.4%, 6.1%)	−30.2% (−33.8%, −26.1%)	1
Mozambique	3853.077 (3292.985, 4500.451)	19.5% (16.7%, 22.3%)	21.7% (18.4%, 25.0%)	4.7% (4.0%, 5.6%)	−13.0% (−17.3%, −8.7%)	1
Kenya	3000.991 (2667.260, 3336.807)	15.3% (13.5%, 17.1%)	18.1% (15.8%, 20.5%)	3.7% (3.4%, 4.0%)	−53.5% (−57.6%, −49.4%)	1
Uganda	2868.064 (2520.930, 3238.720)	14.7% (12.9%, 16.7%)	17.2% (14.9%, 19.7%)	3.5% (3.2%, 3.8%)	−53.3% (−58.8%, −46.9%)	1
Congo, the Democratic Republic of the	2734.090 (2301.912, 3238.823)	4.8% (4.0%, 5.8%)	5.9% (4.9%, 7.2%)	3.3% (3.0%, 3.7%)	−2.7% (−4.4%, −1.0%)	5
Malawi	2631.089 (2371.300, 2905.022)	21.0% (18.8%, 23.6%)	23.6% (21.0%, 26.6%)	3.2% (3.0%, 3.5%)	−40.8% (−44.3%, −36.6%)	1
Russian Federation	2371.550 (1912.480, 2853.925)	3.7% (3.0%, 4.5%)	2.5% (1.9%, 3.0%)	2.9% (2.3%, 3.5%)	−0.5% (−5.3%, 4.0%)	4
Zimbabwe	2332.785 (2109.610, 2561.014)	25.2% (23.2%, 27.6%)	25.2% (22.7%, 27.8%)	2.9% (2.6%, 3.1%)	−47.5% (−51.5%, −43.2%)	1
Zambia	1831.769 (1592.574, 2077.554)	18.3% (16.1%, 20.7%)	20.0% (17.3%, 23.0%)	2.2% (2.1%, 2.4%)	−60.5% (−64.9%, −55.0%)	1
China	1751.701 (1258.816, 2330.904)	0.6% (0.4%, 0.7%)	0.4% (0.3%, 0.6%)	2.2% (1.5%, 2.9%)	0.0% (0.0%, 0.0%)	38
Cameroon	1548.028 (1309.968, 1814.597)	11.7% (9.8%, 13.8%)	13.6% (11.4%, 16.2%)	1.9% (1.7%, 2.2%)	−22.3% (−30.8%, −12.4%)	2
Ethiopia	1317.546 (1083.156, 1558.28)	3.0% (2.4%, 3.6%)	3.1% (2.5%, 3.8%)	1.6% (1.4%, 1.8%)	−67.6% (−72.3%, −62.9%)	8
Côte d'Ivoire	1200.274 (1012.450, 1389.329)	8.1% (6.7%, 9.5%)	9.5% (7.9%, 11.3%)	1.5% (1.3%, 1.7%)	−50.1% (−57.4%, −40.9%)	4
Thailand	1123.300 (959.228, 1332.434)	5.6% (4.8%, 6.6%)	4.4% (3.6%, 5.5%)	1.4% (1.2%, 1.7%)	−58.8% (−64.2%, −50.3%)	1
Myanmar	1098.668 (819.800, 1463.160)	5.1% (4.2%, 6.2%)	5.1% (4.1%, 6.3%)	1.3% (1.0%, 1.8%)	−10.9% (−23.4%, 2.3%)	4
Ukraine	1044.023 (840.529, 1292.452)	5.1% (4.1%, 6.3%)	3.3% (2.6%, 4.2%)	1.3% (1.1%, 1.5%)	−2.0% (−4.5%, 0.1%)	3
Brazil	993.330 (818.809, 1201.471)	1.8% (1.5%, 2.2%)	1.7% (1.3%, 2.2%)	1.2% (1.0%, 1.5%)	−45.3% (−58.1%, −31.2%)	11
Sudan	886.974 (621.793, 1169.102)	4.7% (3.2%, 6.2%)	6.4% (4.3%, 8.6%)	1.1% (0.8%, 1.4%)	−0.8% (−3.8%, 5.6%)	4
Ghana	886.554 (756.301, 1041.249)	7.7% (6.5%, 9.1%)	8.9% (7.5%, 10.6%)	1.1% (1.0%, 1.2%)	−31.0% (−39.9%, −20.3%)	2
Lesotho	680.410 (619.487, 746.453)	32.8% (30.1%, 36.1%)	33.0% (29.9%, 36.4%)	0.8% (0.8%, 0.9%)	−26.1% (−29.4%, −22.8%)	1
Angola	664.303 (413.188, 1020.523)	5.8% (3.8%, 8.5%)	7.0% (4.3%, 10.6%)	0.8% (0.5%, 1.2%)	−7.3% (−24.5%, 14.0%)	4
Indonesia	650.613 (392.311, 984.665)	0.8% (0.5%, 1.3%)	0.8% (0.4%, 1.2%)	0.8% (0.5%, 1.2%)	0.0% (0.0%, 0.0%)	30
Viet Nam	618.322 (473.224, 786.714)	2.9% (2.2%, 3.7%)	2.6% (1.9%, 3.4%)	0.8% (0.6%, 1.0%)	0.0% (0.0%, 0.0%)	6
United States	587.495 (514.663, 662.786)	0.7% (0.6%, 0.8%)	0.5% (0.4%, 0.5%)	0.7% (0.6%, 0.8%)	−75.6% (−78.9%, −71.6%)	34
Burundi	553.394 (387.069, 718.847)	8.9% (6.7%, 10.3%)	10.0% (7.6%, 11.7%)	0.7% (0.5%, 0.9%)	−45.5% (−67.2%, −28.5%)	2
Central African Republic	488.383 (407.268, 575.145)	10.7% (9.1%, 12.3%)	12.6% (10.5%, 14.8%)	0.6% (0.5%, 0.7%)	−5.9% (−19.9%, 15.1%)	3
Chad	482.579 (381.818, 602.494)	4.5% (3.5%, 5.7%)	5.5% (4.1%, 7.2%)	0.6% (0.5%, 0.7%)	−35.9% (−45.9%, −21.6%)	5
Colombia	479.460 (340.898, 657.335)	4.0% (2.9%, 5.4%)	4.3% (2.9%, 6.0%)	0.6% (0.4%, 0.8%)	−11.9% (−18.2%, −3.7%)	4
Burkina Faso	368.232 (298.202, 448.533)	2.4% (1.9%, 3.0%)	3.1% (2.4%, 3.9%)	0.5% (0.4%, 0.6%)	−69.0% (−73.9%, −56.1%)	8
Swaziland	361.430 (325.628, 399.896)	37.0% (33.4%, 40.6%)	37.5% (33.3%, 42.1%)	0.4% (0.4%, 0.5%)	−30.3% (−33.6%, −25.5%)	1
Mali	333.827 (247.092, 425.618)	2.5% (1.8%, 3.4%)	3.4% (2.3%, 4.6%)	0.4% (0.3%, 0.5%)	−44.5% (−61.8%, −22.4%)	10
Togo	290.545 (245.359, 347.383)	7.6% (6.2%, 9.2%)	8.9% (7.3%, 11.1%)	0.4% (0.3%, 0.4%)	−13.4% (−18.1%, −9.6%)	3
Rwanda	286.722 (213.082, 361.762)	5.5% (4.0%, 7.0%)	6.3% (4.5%, 8.1%)	0.4% (0.3%, 0.4%)	−83.1% (−87.9%, −75.4%)	3
Venezuela	277.018 (200.431, 362.801)	3.6% (2.6%, 4.8%)	3.4% (2.4%, 4.5%)	0.3% (0.3%, 0.4%)	−4.7% (−8.9%, −1.5%)	5
Somalia	265.788 (181.919, 392.148)	3.7% (2.5%, 5.2%)	4.6% (3.1%, 6.7%)	0.3% (0.2%, 0.5%)	0.0% (0.0%, 0.0%)	5
Namibia	260.588 (168.426, 356.167)	23.4% (16.3%, 30.1%)	23.1% (15.1%, 30.7%)	0.3% (0.2%, 0.4%)	−66.2% (−75.2%, −58.4%)	1
Mexico	253.760 (81.821, 485.491)	1.0% (0.3%, 1.9%)	0.8% (0.2%, 1.7%)	0.3% (0.1%, 0.6%)	−69.2% (−86.9%, −28.5%)	30
Congo	244.566 (210.586, 286.990)	9.7% (8.1%, 11.6%)	10.5% (8.6%, 12.8%)	0.3% (0.3%, 0.3%)	−44.0% (−52.7%, −32.6%)	1
Malaysia	235.735 (182.263, 321.939)	3.6% (2.7%, 4.8%)	3.7% (2.8%, 5.1%)	0.3% (0.2%, 0.4%)	−15.1% (−23.9%, −4.4%)	5
Botswana	232.001 (207.821, 253.798)	30.4% (27.3%, 33.3%)	35.4% (31.3%, 40.0%)	0.3% (0.3%, 0.3%)	−74.0% (−76.5%, −71.0%)	1
Nepal	217.744 (140.530, 355.663)	2.1% (1.3%, 3.3%)	2.6% (1.6%, 4.3%)	0.3% (0.2%, 0.4%)	−9.8% (−27.1%, 10.5%)	14
Madagascar	202.962 (153.435, 255.767)	2.0% (1.5%, 2.6%)	2.5% (1.8%, 3.3%)	0.2% (0.2%, 0.3%)	−5.5% (−23.5%, 12.2%)	12
Guinea	202.798 (150.422, 267.384)	2.8% (2.0%, 3.7%)	3.3% (2.4%, 4.5%)	0.2% (0.2%, 0.3%)	−40.2% (−55.8%, −17.7%)	9

(*continued overleaf*)

Table 2 (*continued*)

Country[a]	HIV/AIDS DALY number (in thousands)	% of total DALYs attributable to HIV/AIDS	% of deaths attributable to HIV/AIDS	% of global HIV/AIDS deaths	% change of deaths from peak to present	HIV/AIDS DALY rank
Pakistan	202.141 (123.765, 413.193)	0.3% (0.2%, 0.5%)	0.3% (0.2%, 0.6%)	0.2% (0.2%, 0.5%)	0.0% (0.0%, 0.0%)	62
Niger	181.019 (162.976, 206.315)	1.3% (1.1%, 1.5%)	1.8% (1.5%, 2.2%)	0.2% (0.2%, 0.2%)	−23.9% (−26.7%, −18.8%)	11
Benin	150.467 (117.805, 182.469)	3.0% (2.3%, 3.7%)	3.6% (2.7%, 4.5%)	0.2% (0.1%, 0.2%)	−60.0% (−72.2%, −32.2%)	10
Sierra Leone	131.187 (109.251, 155.300)	3.3% (2.7%, 4.0%)	4.4% (3.6%, 5.5%)	0.2% (0.1%, 0.2%)	−5.1% (−9.2%, 0.1%)	7
Peru	130.901 (51.836, 254.507)	1.8% (0.7%, 3.6%)	1.9% (0.7%, 3.9%)	0.2% (0.1%, 0.3%)	−54.7% (−83.0%, −11.5%)	17
Senegal	121.913 (73.858, 185.206)	2.1% (1.3%, 3.2%)	2.8% (1.5%, 4.4%)	0.1% (0.1%, 0.2%)	−15.7% (−26.2%, −8.0%)	10
Gabon	117.338 (67.003, 173.600)	13.2% (7.9%, 19.1%)	13.2% (7.4%, 19.8%)	0.1% (0.1%, 0.2%)	−18.4% (−37.5%, 5.1%)	1
Liberia	116.743 (95.635, 143.626)	3.6% (2.9%, 4.5%)	4.8% (3.8%, 5.9%)	0.1% (0.1%, 0.2%)	−23.4% (−37.4%, −1.5%)	6
Iran, Islamic Republic	114.605 (99.072, 132.010)	0.6% (0.5%, 0.7%)	0.7% (0.6%, 0.8%)	0.1% (0.1%, 0.2%)	−11.9% (−22.6%, 5.1%)	33
Haiti	113.863 (77.312, 172.118)	0.8% (0.4%, 1.4%)	0.7% (0.3%, 1.3%)	0.1% (0.1%, 0.2%)	−80.4% (−86.5%, −63.5%)	13
Dominican Republic	99.618 (74.507, 131.373)	3.5% (2.6%, 4.6%)	3.1% (2.2%, 4.2%)	0.1% (0.1%, 0.2%)	−58.6% (−68.5%, −45.2%)	6
Guatemala	93.800 (37.936, 180.740)	2.0% (0.8%, 3.9%)	2.1% (0.7%, 4.3%)	0.1% (0.0%, 0.2%)	0.0% (0.0%, 0.0%)	13
Eritrea	92.498 (33.058, 200.795)	3.2% (1.2%, 6.6%)	3.8% (1.2%, 8.2%)	0.1% (0.0%, 0.2%)	−44.4% (−70.1%, −16.5%)	9
Argentina	90.351 (79.079, 102.903)	0.8% (0.7%, 1.0%)	0.6% (0.5%, 0.7%)	0.1% (0.1%, 0.1%)	−22.0% (−34.1%, −7.8%)	32
Papua New Guinea	88.386 (56.119, 134.602)	2.5% (1.7%, 3.4%)	2.3% (1.5%, 3.2%)	0.1% (0.1%, 0.2%)	−51.2% (−66.3%, −34.5%)	6
Ecuador	82.083 (40.351, 137.704)	2.3% (1.1%, 3.8%)	2.6% (1.2%, 4.5%)	0.1% (0.1%, 0.2%)	−21.5% (−46.5%, 16.6%)	12
Cambodia	82.054 (47.590, 172.970)	1.6% (0.9%, 3.4%)	1.5% (0.8%, 3.5%)	0.1% (0.1%, 0.2%)	−86.2% (−89.4%, −68.8%)	16
Uzbekistan	78.136 (50.829, 111.878)	0.8% (0.6%, 1.2%)	1.0% (0.6%, 1.4%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	27
Morocco	77.079 (48.165, 131.838)	0.8% (0.5%, 1.4%)	0.9% (0.5%, 1.5%)	0.1% (0.1%, 0.2%)	−8.7% (−39.9%, 36.3%)	36
Honduras	70.454 (36.224, 115.581)	3.3% (1.7%, 5.3%)	3.6% (1.7%, 6.0%)	0.1% (0.0%, 0.1%)	−37.9% (−59.4%, −1.3%)	7
Equatorial Guinea	65.337 (36.331, 98.197)	12.1% (7.3%, 17.7%)	14.4% (8.3%, 21.5%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	1
Bolivia	60.820 (37.022, 89.851)	1.8% (1.1%, 2.7%)	2.3% (1.3%, 3.5%)	0.1% (0.0%, 0.1%)	−7.6% (−41.5%, 25.5%)	14
Jamaica	57.496 (37.513, 81.274)	7.4% (5.0%, 10.2%)	6.5% (4.2%, 9.3%)	0.1% (0.0%, 0.1%)	−49.5% (−62.2%, −32.0%)	1
Spain	56.243 (47.878, 65.193)	0.5% (0.4%, 0.6%)	0.3% (0.2%, 0.3%)	0.1% (0.1%, 0.1%)	−84.8% (−87.5%, −81.4%)	44
Italy	55.269 (47.017, 64.301)	0.3% (0.3%, 0.4%)	0.2% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	−79.8% (−83.4%, −75.0%)	56
Djibouti	53.316 (33.465, 83.773)	12.0% (8.2%, 17.3%)	13.9% (9.0%, 20.5%)	0.1% (0.0%, 0.1%)	−18.0% (−46.6%, 23.7%)	1
Mauritania	52.505 (29.850, 83.348)	3.0% (1.8%, 4.8%)	3.9% (2.1%, 6.5%)	0.1% (0.0%, 0.1%)	−3.1% (−36.0%, 36.2%)	10
France	48.908 (41.904, 56.833)	0.3% (0.3%, 0.3%)	0.2% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	−82.1% (−85.2%, −78.0%)	61
Algeria	48.627 (33.899, 65.595)	0.6% (0.4%, 0.8%)	0.7% (0.4%, 0.9%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	39
Gambia	46.859 (14.259, 113.562)	4.6% (1.5%, 10.7%)	6.2% (1.7%, 14.4%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	6
Panama	43.934 (22.383, 75.113)	5.2% (2.8%, 8.6%)	5.1% (2.5%, 8.6%)	0.1% (0.0%, 0.1%)	−51.8% (−76.4%, −13.3%)	2
Portugal	42.759 (36.893, 48.911)	1.4% (1.2%, 1.7%)	0.8% (0.7%, 0.9%)	0.1% (0.0%, 0.1%)	−28.9% (−40.6%, −14.7%)	24
Guinea-Bissau	40.327 (25.223, 61.72)	3.3% (2.1%, 4.9%)	3.8% (2.3%, 6.0%)	0.0% (0.0%, 0.1%)	−31.0% (−45.1%, −14.5%)	8
Kyrgyzstan	38.870 (21.261, 64.297)	1.9% (1.1%, 3.1%)	2.0% (1.1%, 3.4%)	0.0% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	15
Kazakhstan	33.761 (28.206, 40.881)	0.5% (0.4%, 0.6%)	0.5% (0.4%, 0.6%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	40
Canada	32.963 (27.214, 39.927)	0.4% (0.3%, 0.5%)	0.2% (0.2%, 0.3%)	0.0% (0.0%, 0.0%)	−66.6% (−73.5%, −57.0%)	49
Romania	32.850 (21.857, 45.866)	0.4% (0.3%, 0.6%)	0.3% (0.2%, 0.4%)	0.0% (0.0%, 0.1%)	−11.0% (−19.8%, 0.2%)	46
Tunisia	32.140 (18.314, 47.484)	1.3% (0.8%, 1.9%)	1.3% (0.8%, 1.9%)	0.0% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	21
Chile	31.278 (26.109, 37.860)	0.8% (0.7%, 1.0%)	0.6% (0.5%, 0.7%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	33
Moldova	30.638 (25.165, 36.928)	2.1% (1.7%, 2.6%)	1.5% (1.2%, 1.9%)	0.0% (0.0%, 0.0%)	−5.0% (−13.9%, 0.8%)	10
El Salvador	30.222 (9.145, 72.508)	1.8% (0.5%, 4.1%)	1.5% (0.4%, 3.8%)	0.0% (0.0%, 0.1%)	−49.9% (−88.7%, 56.3%)	20
Trinidad and Tobago	29.330 (26.319, 32.550)	6.4% (5.6%, 7.3%)	5.9% (5.1%, 6.7%)	0.0% (0.0%, 0.0%)	−22.6% (−30.7%, −11.7%)	3
Germany	29.224 (25.458, 33.116)	0.1% (0.1%, 0.1%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−75.3% (−79.8%, −70.9%)	94
Tajikistan	28.214 (16.961, 39.411)	1.2% (0.7%, 1.6%)	1.5% (0.8%, 2.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	22
Greece	26.674 (22.202, 31.726)	0.8% (0.7%, 1.0%)	0.5% (0.4%, 0.6%)	0.0% (0.0%, 0.0%)	−32.7% (−49.3%, −21.5%)	25
Paraguay	24.682 (7.259, 50.923)	1.4% (0.4%, 2.9%)	1.4% (0.3%, 3.0%)	0.0% (0.0%, 0.1%)	−29.6% (−69.4%, 17.4%)	24
Afghanistan	24.041 (12.641, 48.308)	0.1% (0.1%, 0.2%)	0.1% (0.1%, 0.3%)	0.0% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	77
Mauritius	23.976 (19.610, 29.302)	6.5% (5.4%, 8.0%)	5.3% (4.0%, 7.1%)	0.0% (0.0%, 0.0%)	−5.7% (−13.1%, 1.9%)	3
Turkmenistan	22.889 (12.659, 33.554)	1.5% (0.8%, 2.1%)	1.6% (0.9%, 2.2%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	18
United Kingdom	22.208 (18.939, 25.759)	0.1% (0.1%, 0.2%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−63.5% (−69.0%, −56.5%)	91
Korea, Republic of	21.671 (16.485, 28.126)	0.2% (0.2%, 0.3%)	0.2% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	−11.7% (−14.5%, −8.4%)	67
Cuba	21.117 (10.586, 38.305)	0.7% (0.3%, 1.2%)	0.2% (0.2%, 0.2%)	0.0% (0.0%, 0.0%)	−0.6% (−20.5%, 22.9%)	38
Egypt	20.931 (12.958, 32.732)	0.1% (0.1%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	94

Guyana	20.299 (6.869, 41.073)	7.0% (2.5%, 13.2%)	6.8% (2.2%, 13.5%)	0.0% (0.0%, 0.0%)	−60.6% (−82.2%, −35.8%)	2
Philippines	19.334 (12.917, 25.980)	0.1% (0.0%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	114
Latvia	18.655 (14.068, 24.059)	2.2% (1.6%, 2.8%)	1.4% (1.0%, 1.8%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	9
Serbia	17.720 (11.487, 24.665)	0.6% (0.4%, 0.8%)	0.4% (0.2%, 0.5%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	37
Bahamas	16.690 (15.571, 17.907)	15.8% (14.3%, 17.3%)	19.4% (17.5%, 21.2%)	0.0% (0.0%, 0.0%)	−35.7% (−40.2%, −31.3%)	1
Suriname	14.824 (13.025, 17.052)	8.8% (7.7%, 10.1%)	9.4% (8.0%, 11.2%)	0.0% (0.0%, 0.0%)	−27.3% (−42.3%, −8.4%)	1
Lao People's Democratic Republic	13.863 (5.010, 33.900)	0.5% (0.2%, 1.3%)	0.5% (0.1%, 1.4%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	45
Taiwan	13.768 (10.918, 17.222)	0.3% (0.2%, 0.3%)	0.2% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	67
Estonia	13.431 (10.352, 16.861)	3.0% (2.3%, 3.8%)	1.8% (1.3%, 2.4%)	0.0% (0.0%, 0.0%)	−5.3% (−11.1%, −0.6%)	5
Belarus	12.747 (4.649, 25.540)	0.3% (0.1%, 0.6%)	0.2% (0.1%, 0.4%)	0.0% (0.0%, 0.0%)	−31.4% (−62.2%, 14.7%)	59
United Arab Emirates	12.129 (6.378, 19.932)	0.9% (0.4%, 1.4%)	1.8% (0.9%, 2.9%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	28
Poland	12.076 (9.624, 14.953)	0.1% (0.1%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−62.5% (−73.5%, −46.6%)	104
Bangladesh	11.817 (7.759, 15.783)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	136
Bulgaria	9.669 (7.033, 12.722)	0.3% (0.2%, 0.4%)	0.2% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	50
Belize	9.661 (8.139, 11.456)	10.5% (8.8%, 12.7%)	11.1% (8.9%, 13.7%)	0.0% (0.0%, 0.0%)	−11.3% (−33.1%, 58.8%)	1
Sri Lanka	9.506 (6.725, 12.831)	0.2% (0.1%, 0.2%)	0.1% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	76
Korea, Democratic People's Republic	9.291 (7.207, 11.846)	0.1% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	93
Saudi Arabia	9.142 (4.952, 14.679)	0.2% (0.1%, 0.3%)	0.2% (0.1%, 0.4%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	74
Costa Rica	8.819 (7.551, 10.129)	0.9% (0.8%, 1.1%)	0.9% (0.7%, 1.0%)	0.0% (0.0%, 0.0%)	−24.9% (−38.3%, −10.5%)	30
Lebanon	8.524 (4.660, 13.686)	0.9% (0.5%, 1.5%)	0.8% (0.4%, 1.4%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	28
Uruguay	8.369 (6.846, 10.28)	0.9% (0.7%, 1.1%)	0.5% (0.4%, 0.6%)	0.0% (0.0%, 0.0%)	−8.1% (−22.4%, 9.7%)	32
Yemen	8.210 (6.098, 10.875)	0.1% (0.1%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−9.1% (−36.3%, 29.9%)	84
Australia	8.156 (6.750, 9.769)	0.2% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−77.9% (−82.4%, −72.5%)	84
Hungary	7.908 (5.944, 10.057)	0.2% (0.2%, 0.3%)	0.1% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	−68.7% (−80.4%, −50.1%)	68
Azerbaijan	7.729 (5.195, 10.824)	0.3% (0.2%, 0.4%)	0.3% (0.2%, 0.4%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	55
Libyan Arab Jamahiriya	7.215 (5.181, 9.861)	0.5% (0.3%, 0.6%)	0.5% (0.4%, 0.7%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	48
Turkey	6.758 (3.793, 10.427)	0.0% (0.0%, 0.1%)	0.0% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−25.5% (−51.7%, 5.5%)	132
Switzerland	6.754 (5.848, 7.731)	0.4% (0.3%, 0.4%)	0.2% (0.2%, 0.2%)	0.0% (0.0%, 0.0%)	−81.6% (−84.8%, −77.4%)	54
Japan	6.731 (5.886, 7.597)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	−59.4% (−65.3%, −53.0%)	135
Armenia	6.543 (3.287, 13.771)	0.7% (0.3%, 1.4%)	0.5% (0.2%, 1.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	37
Cape Verde	5.962 (2.834, 9.730)	4.5% (2.3%, 7.1%)	4.7% (2.1%, 7.4%)	0.0% (0.0%, 0.0%)	−34.6% (−62.8%, −5.7%)	2
Georgia	5.820 (3.602, 8.089)	0.4% (0.2%, 0.5%)	0.2% (0.1%, 0.3%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	50
Belgium	5.266 (4.483, 6.120)	0.2% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−59.9% (−66.5%, −50.5%)	76
Netherlands	5.205 (4.468, 5.965)	0.1% (0.1%, 0.1%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−83.8% (−86.5%, −80.6%)	94
Nicaragua	4.338 (1.067, 19.944)	0.3% (0.1%, 1.4%)	0.3% (0.0%, 1.5%)	0.0% (0.0%, 0.0%)	−64.8% (−83.1%, 19.8%)	76
Syrian Arab Republic	4.022 (2.287, 6.320)	0.1% (0.1%, 0.2%)	0.1% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	97
Austria	3.844 (3.261, 4.489)	0.2% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−70.7% (−76.0%, −64.8%)	78
Bahrain	3.566 (1.877, 5.868)	1.4% (0.7%, 2.2%)	2.4% (1.2%, 3.8%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	18
Lithuania	3.538 (2.500, 4.790)	0.3% (0.2%, 0.4%)	0.2% (0.1%, 0.3%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	60
Israel	3.246 (2.561, 4.183)	0.2% (0.2%, 0.3%)	0.1% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	−60.3% (−71.4%, −44.1%)	72
Singapore	3.081 (2.653, 3.576)	0.4% (0.4%, 0.5%)	0.4% (0.3%, 0.5%)	0.0% (0.0%, 0.0%)	−45.9% (−53.8%, −35.6%)	45
Denmark	2.849 (2.422, 3.282)	0.2% (0.2%, 0.2%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−77.3% (−81.7%, −71.9%)	78
Kuwait	2.746 (1.494, 4.326)	0.5% (0.3%, 0.8%)	0.8% (0.4%, 1.3%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	42
Sao Tome and Principe	2.539 (1.645, 3.733)	4.4% (2.9%, 6.3%)	5.8% (3.5%, 8.6%)	0.0% (0.0%, 0.0%)	−22.3% (−47.6%, 15.2%)	5
Macedonia, the Former Yugoslav Republic of	2.405 (1.973, 2.859)	0.4% (0.3%, 0.5%)	0.3% (0.2%, 0.3%)	0.0% (0.0%, 0.0%)	−37.9% (−54.7%, −25.4%)	46
Bosnia and Herzegovina	2.391 (2.011, 2.808)	0.2% (0.2%, 0.3%)	0.1% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	−23.8% (−40.9%, 7.5%)	71
Albania	2.374 (1.946, 2.877)	0.3% (0.2%, 0.3%)	0.2% (0.2%, 0.3%)	0.0% (0.0%, 0.0%)	−30.2% (−49.0%, −15.6%)	58
Barbados	2.047 (1.700, 2.403)	2.4% (2.0%, 2.8%)	1.8% (1.5%, 2.1%)	0.0% (0.0%, 0.0%)	−58.5% (−67.0%, −48.5%)	9

(*continued overleaf*)

Table 2 (*continued*)

Country[a]	HIV/AIDS DALY number (in thousands)	% of total DALYs attributable to HIV/AIDS	% of deaths attributable to HIV/AIDS	% of global HIV/AIDS deaths	% change of deaths from peak to present	HIV/AIDS DALY rank
Sweden	1.943 (1.657, 2.258)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	−77.7% (−81.5%, −73.4%)	105
Bhutan	1.765 (1.103, 2.630)	0.7% (0.4%, 1.0%)	0.7% (0.4%, 1.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	36
Ireland	1.722 (1.455, 2.046)	0.2% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−75.8% (−80.2%, −69.7%)	87
Jordan	1.269 (.709, 2.040)	0.1% (0.1%, 0.2%)	0.1% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	100
Saint Vincent and the Grenadines	1.264 (1.104, 1.454)	3.6% (3.1%, 4.2%)	3.2% (2.7%, 3.7%)	0.0% (0.0%, 0.0%)	−42.0% (−51.3%, −30.3%)	6
Norway	1.232 (1.046, 1.427)	0.1% (0.1%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−72.2% (−77.7%, −66.2%)	100
Finland	1.224 (1.040, 1.439)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−50.8% (−62.0%, −34.4%)	105
Fiji	1.128 (0.746, 1.599)	0.4% (0.2%, 0.5%)	0.3% (0.2%, 0.5%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	61
Mongolia	1.066 (0.665, 1.430)	0.1% (0.1%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	90
Oman	0.992 (0.786, 1.498)	0.2% (0.1%, 0.3%)	0.2% (0.2%, 0.4%)	0.0% (0.0%, 0.0%)	−57.7% (−71.4%, −25.8%)	74
Czech Republic	0.982 (.837, 1.138)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	−43.4% (−55.2%, −26.7%)	124
Croatia	0.977 (0.762, 1.240)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	−14.7% (−18.8%, −10.1%)	109
Qatar	0.952 (0.490, 1.533)	0.3% (0.2%, 0.5%)	0.7% (0.4%, 1.2%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	55
Saint Lucia	0.927 (0.794, 1.075)	1.8% (1.5%, 2.1%)	1.2% (1.0%, 1.4%)	0.0% (0.0%, 0.0%)	−20.5% (−33.9%, −3.9%)	12
New Zealand	0.910 (0.766, 1.095)	0.1% (0.1%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−85.4% (−88.6%, −81.3%)	99
Cyprus	0.588 (0.542, 0.634)	0.3% (0.3%, 0.4%)	0.2% (0.2%, 0.2%)	0.0% (0.0%, 0.0%)	−62.7% (−66.0%, −59.6%)	58
Grenada	0.564 (0.484, 0.652)	1.7% (1.5%, 2.0%)	1.1% (0.9%, 1.3%)	0.0% (0.0%, 0.0%)	−30.6% (−43.4%, −13.8%)	13
Slovenia	0.547 (0.415, 0.714)	0.1% (0.1%, 0.1%)	0.1% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	−6.3% (−12.4%, 0.8%)	105
Iraq	0.462 (0.257, 0.735)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	162
Seychelles	0.448 (0.390, 0.525)	1.9% (1.7%, 2.3%)	1.8% (1.6%, 2.2%)	0.0% (0.0%, 0.0%)	−26.4% (−31.9%, −20.0%)	13
Antigua and Barbuda	0.398 (0.346, 0.461)	1.7% (1.5%, 2.0%)	1.2% (1.0%, 1.4%)	0.0% (0.0%, 0.0%)	−30.7% (−43.1%, −13.5%)	14
Iceland	0.385 (0.310, 0.475)	0.6% (0.4%, 0.7%)	0.4% (0.3%, 0.5%)	0.0% (0.0%, 0.0%)	−17.6% (−31.9%, 1.7%)	39
Slovakia	0.374 (0.281, 0.492)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	−5.2% (−12.1%, 3.8%)	133
Dominica	0.363 (0.313, 0.418)	1.7% (1.4%, 2.0%)	1.2% (1.0%, 1.4%)	0.0% (0.0%, 0.0%)	−65.8% (−72.3%, −57.7%)	12
Luxembourg	0.333 (0.293, 0.375)	0.3% (0.2%, 0.3%)	0.1% (0.1%, 0.2%)	0.0% (0.0%, 0.0%)	−65.8% (−71.2%, −59.7%)	63
Brunei Darussalam	0.216 (0.191, 0.244)	0.3% (0.2%, 0.3%)	0.3% (0.2%, 0.3%)	0.0% (0.0%, 0.0%)	−24.8% (−37.7%, 1.0%)	67
Kiribati	0.196 (0.142, 0.264)	0.5% (0.3%, 0.6%)	0.4% (0.3%, 0.5%)	0.0% (0.0%, 0.0%)	−50.5% (−61.0%, −38.1%)	49
Malta	0.143 (0.127, 0.160)	0.1% (0.1%, 0.2%)	0.1% (0.1%, 0.1%)	0.0% (0.0%, 0.0%)	−57.7% (−64.2%, −49.8%)	86
Maldives	0.102 (0.08, 0.128)	0.2% (0.1%, 0.2%)	0.2% (0.2%, 0.3%)	0.0% (0.0%, 0.0%)	−52.2% (−64.2%, −36.6%)	85
Montenegro	0.094 (0.074, 0.119)	0.0% (0.0%, 0.1%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	−12.0% (−16.0%, −7.9%)	120
Occupied Palestinian Territory	0.076 (0.043, 0.119)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	156
Comoros	0.014 (0.006, 0.042)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	159
Timor-Leste	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	–	171
Micronesia, Federated States of	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	–	168
Solomon Islands	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	–	168
Tonga	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	–	166
Marshall Islands	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	–	172
Samoa	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	–	173
Andorra	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	–	164
Vanuatu	0.000 (0.000, 0.000)	0.0% (0.0%, 0.0%)	0.0% (0.0%, 0.0%)	0.0% (0.0%-0.0%)	–	171

[a]Countries ordered by number of HIV/AIDS DALYs.

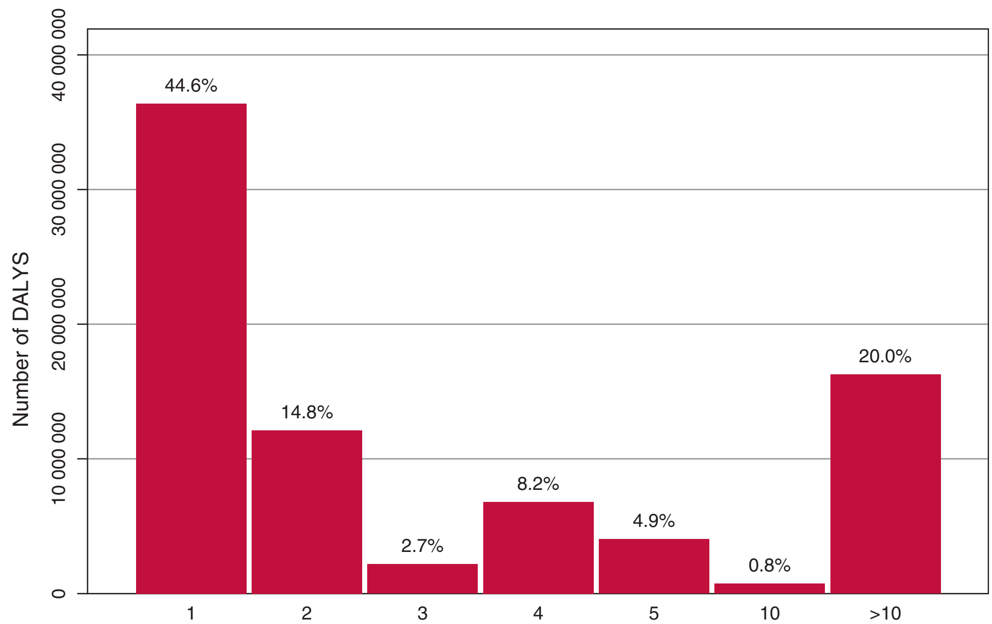

Fig. 5. Summation of country-level HIV/AIDS disability-adjusted life years by rank, 2010. This figure illustrates the summation of HIV/AIDS DALYs for countries with similar HIV/AIDS DALY ranks in 2010. HIV/AIDS DALY ranks are listed along the bottom. The percentages on top of each bar indicate the proportion of global HIV/AIDS DALYs attributable to the summation of DALYs from all countries with that rank.

such as bed nets for malaria [33–35], the scale-up of interventions for HIV/AIDS, particularly ART, stands as one of the extraordinary success stories for global health [5]. Clear and compelling links between donor funding for ART programmes and scale-up provide an excellent case for the impact of some DAH [36,37]. Because HIV/AIDS is concentrated in young adults and in selected countries, the burden, however, remains high even in some countries with marked ART scale-up. GBD 2010 provides a unique opportunity to see HIV/AIDS in context. Despite progress, the message is clear: HIV/AIDS is not gone. In 2010, the epidemic remains the number one cause of burden in 21 countries and the number two cause of burden in seven others. Further, HIV/AIDS mortality continued to increase from 2006 to 2010 in 98 countries. Although many of these countries have small epidemic burdens, greater attention and allocation of resources may need to be directed in these settings.

A number of countries with large epidemics in Eastern and Southern Africa have seen substantial declines in HIV/AIDS mortality, such as Rwanda, Botswana and Zimbabwe (83.1, 74.0 and 47.5% decline in mortality from peak to present, respectively, Table 2). What this means is that, in 2005, 68.7% of global HIV/AIDS burden was in countries where HIV/AIDS is the leading or second leading cause of the burden of disease, and in 2010, this has been reduced to 59.4% (Fig. 5). It is likely easier to maintain policy focus and strong political engagement in the management of HIV/AIDS prevention and treatment programmes in settings where the disease is a truly dominant problem. Demographic and epidemiological trends, however, suggest that we should expect a larger share of the global burden of HIV/AIDS to occur in countries where HIV/AIDS is not a dominant or necessarily leading health problem. For example, HIV/AIDS may contribute to a relatively small fraction of a country's total disease burden but a large fraction of the global HIV/AIDS burden. In 2010, India's HIV/AIDS DALYs accounted for 11.4% of global HIV/AIDS DALYs and only 1.8% of the country's total burden (Table 2). By comparison, diarrhoeal diseases and ischemic heart diseases accounted for 5.2 and 5.1% of India's total DALYs, respectively, in 2010, making it challenging to sustain sufficient priority for HIV/AIDS programmes [38]. The global HIV/AIDS community will need to garner attention on the epidemic increasingly in settings where it is not a nation's dominant health problem. Several studies have shown the future savings in healthcare resources that can occur if low-burden countries invest in HIV/AIDS prevention now [39–42]. This may require different political and technical strategies moving forward.

We worked collaboratively with UNAIDS to generate our HIV/AIDS mortality and prevalence estimates for GBD 2010; however, there are three main methodological differences that are important to note because they result in variations between GBD 2010 and UNAIDS' published 2012 country year specific estimations [43–47]. First, on the basis of our discussions

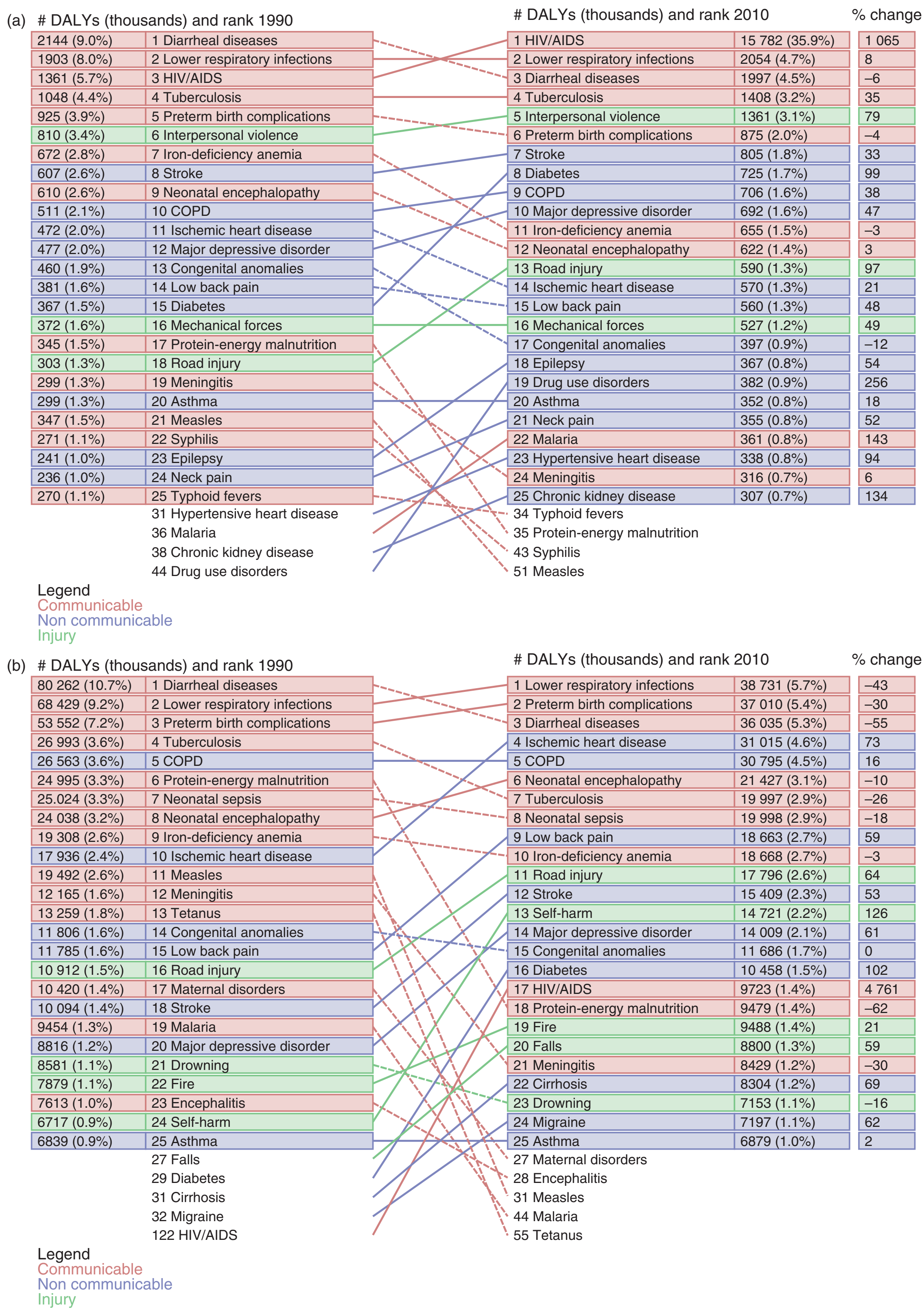

Fig. 6. Southern sub-Saharan Africa and South Asia ranks for top 25 causes of disability-adjusted life years, 1990–2010. (a) Southern sub-Saharan Africa; (b) South Asia. Causes that are communicable, maternal, neonatal or nutritional deficiencies are shown in red, noncommunicable causes are in blue and injuries are in green. Number of regional DALYs and the percentage of regional DALYs attributable to each cause are included. Percentage change in DALYs from 1990 to 2010 by cause is also included on the right-hand side.

with UNAIDS [48], for a number of countries with high-quality vital registration data, we have based our assessments on those sources rather than epidemic models. Many of these countries are high-income, but they also include Uruguay and a number of Caribbean countries (Table 1). Second, for Thailand and Panama, we used UNAIDS 2010 assessments rather than their 2012 revision assessments because of the large divergence between national sources such as vital registration and the 2012 assessment. Since GBD 2010 was published around the same time as the UNAIDS 2012 report, the UNAIDS 2012 revision estimates used in GBD 2010 were preliminary [16]. As a result of the UNAIDS and GBD 2010 collaboration, several of the preliminary UNAIDS 2012 mortality estimates were adjusted; given the frequency of updates and methodological advances, tracing the evolution of specific country estimates across different sources was challenging. Thailand and Panama are examples of countries that were significantly adjusted after our exchange; however, these adjustments did not occur in time for inclusion in GBD 2010 [5,47]. Other countries that were significantly adjusted after our exchange and could not be included in GBD 2010 include Brazil, Central African Republic, Ethiopia and Haiti [5]; we are currently working with the UNAIDS Reference Group on Estimates and Projections to resolve these differences.

The most significant difference in the GBD 2010 and UNAIDS 2012 mortality methodologies, however, was that we made our final HIV/AIDS mortality estimates fit within all-cause mortality estimates on the basis of independent demographic sources. This is fundamentally different from the UNAIDS single-cause modelling approach, which assumes that the data sources used for modelling HIV/AIDS mortality are sufficiently robust to obviate the need for any postestimation review. The empirical basis for assessing the HIV/AIDS epidemic in many countries, however, is rather weak; the number of antenatal care clinics that report data is small and the age–sex specific progression assumptions used in Spectrum, the UNAIDS modelling platform, have a very large impact on the production of their HIV/AIDS mortality estimates [45–47]. On the contrary, demography and the measurement of mortality in populations have a substantially longer history than descriptive epidemiology, certainly for HIV/AIDS. As a result, there are often more datasets available to estimate all-cause mortality, especially for those countries most affected by the epidemic [49]. In most countries, uncertainty intervals for total mortality are considerably smaller than for any significant cause of death, giving us greater faith in these estimates over any cause-specific estimate and thus validating the necessity of the all-cause mortality adjustment [50].

As the all-cause mortality fit is based on uncertainty surrounding the cause-specific estimates [1], this analytical step had a greater impact on causes with large uncertainties surrounding their estimates. For example, the average percentage change over the years in the HIV/AIDS mortality estimates before and after the all-cause mortality adjustment for Nigeria and Cuba were −26.1 and −0.2%, respectively. Of the 187 countries for which HIV/AIDS mortality estimates were generated, 24 countries were adjusted by more than 20% on average across the years and two countries did not have overlapping confidence intervals with the original UNAIDS estimates after the all-cause mortality adjustment (Bahamas and Zimbabwe). If there is a bias at present in the analysis, our major concern is that, due to the underestimation of HIV/AIDS uncertainty by UNAIDS in some key countries, other GBD 2010 causes are inappropriately adjusted more. As a result of these three main methodological differences, UNAIDS does not necessarily support the HIV/AIDS mortality estimates published in the GBD 2010 study. It is important to note, however, that despite numeric differences between GBD 2010 and UNAIDS' 2012 estimates, uncertainty intervals are overlapping at the global level and, more importantly, show similar trends in HIV/AIDS mortality over time [50].

There are some countries where the HIV/AIDS estimates are still particularly unreliable. For the most part, these are countries with mediocre vital registration systems and concentrated epidemics that are very sensitive to estimates of the population at risk (e.g. Russia and Colombia). Due to the nature of these epidemics, the number of HIV/AIDS deaths captured in the vital registration systems are low and, thus, the UNAIDS 2012 estimates for these countries are significantly above the country-recorded HIV/AIDS deaths. The use of UNAIDS HIV/AIDS estimates for these countries in GBD 2010 resulted in surprisingly large HIV/AIDS burdens when compared with other causes. For example, HIV/AIDS ranked as one of the top four leading causes of DALYs in 2010 for both Colombia and Russia (Fig. 3). Other countries with a similar HIV/AIDS estimation problem include Guyana, Suriname and Venezuela, as well as Estonia, Latvia and Lithuania. In these cases, further work is needed to understand the marked divergence between different modelling approaches.

Given the importance of sustaining the efforts to counteract the HIV/AIDS epidemic, it will be important to continue tracking the magnitude of the HIV/AIDS epidemic and also its importance relative to other diseases and injuries. The GBD 2010 effort will be continued and can provide regular updates of the burden of disease at the national level. This will provide a mechanism to incorporate new data on HIV/AIDS as well as other diseases and injuries and levels of all-cause mortality as they become available. We believe that the best science and data should be brought to bear on the estimation of each disease, injury and risk in each country. Although the engagement of local scientists, whether in government or not, can improve science, this can also stagnate and bias modelling efforts due to the politics surrounding these estimates. Unlike the UNAIDS bi-annual effort, the GBD work does not require agreement with countries; the science of measurement and the politics of measurement are kept distinct. UNAIDS has spearheaded major advances in HIV/AIDS surveillance and modelling. In some cases, however, the political requirement to consult with ministries of health has meant that estimates are not published for particular countries. For example, in the UNAIDS 2012 report, no precise mortality estimates were published for China, India or Russia [5].

There are several areas for improvements in the estimation of HIV/AIDS that follow from the GBD analysis. First, for countries where the evidence on patterns of all-cause mortality are different than what is implied by UNAIDS, we believe that further work on the age pattern of HIV/AIDS deaths and the robustness of the demographic sources is a high priority. Second, there are opportunities to improve the estimation process in UNAIDS' Spectrum/Estimation and Projection Package (EPP) model to capture heterogeneity in incidence by age and sex in the EPP phase, explore more fully the evidence on the age and sex patterns of death in the Spectrum component and address relatively implausibly narrow uncertainty intervals produced for countries with large epidemics [45–47]. Third, in countries with complete vital registration, such as many countries in Latin America and Eastern Europe, research on misclassification of HIV/AIDS deaths is urgently needed to improve the tracking of HIV/AIDS-related mortality. Fourth, research on why verbal autopsy has proven so poor at recording HIV-related deaths would be important, as verbal autopsy is likely to be more widely collected in many low-resource settings. Moving forward, efforts need be made to collect the best evidence on the evolution of HIV/AIDS and other leading health problems, for this evidence is an essential global public good that can foster a sustained coherent response to current and future global health challenges.

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Conflicts of interest

There are no conflicts of interest.

References

1. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, *et al*. **Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010.** *Lancet* 2012; **380**:2095–2128.
2. Murray CJL, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, *et al*. **Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010.** *Lancet* 2012; **380**:2197–2223.
3. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M, *et al*. **Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010.** *Lancet* 2012; **380**:2163–2196.
4. WHO. *Global status report on noncommunicable diseases 2010*. Geneva, Switzerland: WHO; 2011.
5. UNAIDS. *UNAIDS Report on the Global AIDS Epidemic: 2012*. Geneva, Switzerland: UNAIDS; 2011.
6. UNAIDS. *2012 progress reports submitted by countries [Internet]*. Geneva, Switzerland: UNAIDS; 2012.
7. UNAIDS. *UNAIDS: the first 10 years [Internet]*. Geneva, Switzerland: UNAIDS; 2008.
8. GFATM. Our history – the global fund to fight AIDS, tuberculosis and malaria [Internet] [cited 12 April 2013]. http://www.theglobalfund.org/en/about/history/ [Accessed 12 April 2013].
9. PEPFAR Watch. About PEPFAR | PEPFAR watch [Internet] [cited 12 April 2013]. http://www.pepfarwatch.org/about_pepfar/ [Accessed 12 April 2013].
10. El-Sadr WM, Holmes CB, Mugyenyi P, Thirumurthy H, Ellerbrock T, Ferris R, *et al*. **Scale-up of HIV treatment through PEPFAR: a historic public health achievement.** *J Acquir Immune Defic Syndr* 2012; **60 (Suppl 3)**:S96–S104.
11. Stover J, Korenromp EL, Blakley M, Komatsu R, Viisainen K, Bollinger L, *et al*. **Long-term costs and health impact of continued global fund support for antiretroviral therapy.** *Plos One* 2011; **6**:e21048.
12. **A strategic revolution in HIV and global health.** *Lancet* 2011; **377**:2055.
13. UNAIDS. *Together we will end AIDS*. Geneva, Switzerland: UNAIDS; 2012.
14. UNAIDS. *Getting to zero: 2011–2015 stratgey*. Geneva, Switzerland: UNAIDS; 2010.
15. Institute for Health Metrics and Evaluation. *Financing global health 2012: the end of the golden age? [Internet]*. Seattle, WA: Institute for Health Metrics and Evaluation; 2012.
16. UNAIDS. *UNAIDS report on the Global AIDS epidemic: 2010*. Geneva, Switzerland: UNAIDS; 2010.
17. UNAIDS. *Global HIV/AIDS response: epidemic update and health sector progress towards universal access 2011*. Geneva, Switzerland: UNAIDS; 2011.
18. UNAIDS. *Report on the global AIDS epidemic: 2008*. Geneva, Switzerland: UNAIDS; 2008.
19. Mathers CD, Murray CJ, Ezzati M, Gakidou E, Salomon JA, Stein C. **Population health metrics: crucial inputs to the development of evidence for health policy.** *Popul Heal Metrics* 2003; **1**:6.
20. Murray CJ, Ezzati M, Flaxman AD, Lim S, Lozano R, Michaud C, *et al*. **GBD 2010: a multiinvestigator collaboration for global comparative descriptive epidemiology.** *Lancet* 2012; **380**:2055–2058.
21. Murray CJ, Ezzati M, Flaxman AD, Lim S, Lozano R, Michaud C, *et al*. **GBD 2010: design, definitions, and metrics.** *Lancet* 2012; **380**:2063–2066.
22. Wang H, Dwyer-Lindgren L, Lofgren KT, Rajaratnam JK, Marcus JR, Levin-Rector A, *et al*. **Age-specific and sex-specific mortality in 187 countries, 1970-2010: a systematic analysis for the Global Burden of Disease Study 2010.** *Lancet* 2012; **380**:2071–2094.
23. Salomon JA, Vos T, Hogan DR, Gagnon M, Naghavi M, Mokdad A, *et al*. **Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010.** *Lancet* 2012; **380**:2129–2143.
24. Salomon JA, Wang H, Freeman MK, Vos T, Flaxman AD, Lopez AD, *et al*. **Healthy life expectancy for 187 countries, 1990-2010: a systematic analysis for the Global Burden Disease Study 2010.** *Lancet* 2012; **380**:2144–2162.

25. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, *et al*. **A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010.** *Lancet* 2012; **380**:2224–2260.
26. Foreman KJ, Lozano R, Lopez AD, Murray CJ. **Modeling causes of death: an integrated approach using CODEm.** *Popul Heal Metrics* 2012; **10**:1.
27. King G, Tomz M, Wittenberg J. **Making the most of statistical analyses: improving interpretation and presentation.** *Am J Polit Sci* 2000; **44**:347–361.
28. Institute for Health Metrics and Evaluation. *Critical ethical choices for DALYs meeting.* Seattle, WA: Institute for Health Metrics and Evaluation; 2011.
29. WHO. WHO download data as CSV files [Internet]. WHO; 2013; [cited 12 April 2013]. http://www.who.int/tb/country/data/download/en/index.html [Accessed 12 April 2013].
30. Stringer JSA, Zulu I, Levy J, Stringer EM, Mwango A, Chi BH, *et al*. **Rapid scale-up of antiretroviral therapy at primary care sites in Zambia: feasibility and early outcomes.** *JAMA* 2006; **296**:782–793.
31. Mermin J, Were W, Ekwaru JP, Moore D, Downing R, Behumbiize P, *et al*. **Mortality in HIV-infected Ugandan adults receiving antiretroviral treatment and survival of their HIV-uninfected children: a prospective cohort study.** *Lancet* 2008; **371**:752–759.
32. Schouten EJ, Jahn A, Midiani D, Makombe SD, Mnthambala A, Chirwa Z, *et al*. **Prevention of mother-to-child transmission of HIV and the health-related Millennium Development Goals: time for a public health approach.** *Lancet* 2011; **378**:282–284.
33. WHO Global Malaria Programme. *World malaria report: 2012.* Geneva, Switzerland: WHO Global Malaria Programme; 2012
34. D'Alessandro U, Olaleye BO, McGuire W, Langerock P, Bennett S, Aikins MK, *et al*. **Mortality and morbidity from malaria in Gambian children after introduction of an impregnated bednet programme.** *Lancet* 1995; **345**:479–483.
35. Fegan GW, Noor AM, Akhwale WS, Cousens S, Snow RW. **Effect of expanded insecticide-treated bednet coverage on child survival in rural Kenya: a longitudinal study.** *Lancet* 2007; **370**:1035–1039.
36. Rasschaert F, Pirard M, Philips MP, Atun R, Wouters E, Assefa Y, *et al*. **Positive spill-over effects of ART scale up on wider health systems development: evidence from Ethiopia and Malawi.** *J Int AIDS Soc* 2011; **14 (Suppl 1)**:S3.
37. Assefa Y, Jerene D, Lulseged S, Ooms G, Van Damme W. **Rapid scale-up of antiretroviral treatment in Ethiopia: successes and system-wide effects.** *Plos Med* 2009; **6**:e1000056.
38. GBD 2010 Country Collaboration. **GBD 2010 country results: a global public good.** *Lancet* 2013; **381**:965–970.
39. Creese A, Floyd K, Alban A, Guinness L. **Cost-effectiveness of HIV/AIDS interventions in Africa: a systematic review of the evidence.** *Lancet* 2002; **359**:1635–1643.
40. Sweat M, Gregorich S, Sangiwa G, Furlonge C, Balmer D, Kamenga C, *et al*. **Cost-effectiveness of voluntary HIV-1 counselling and testing in reducing sexual transmission of HIV-1 in Kenya and Tanzania.** *Lancet* 2000; **356**:113–121.
41. Kahn JG, Marseille E, Auvert B. **Cost-effectiveness of male circumcision for HIV prevention in a South African setting.** *Plos Med* 2006; **3**:e517.
42. Schwartländer B, Stover J, Hallett T, Atun R, Avila C, Gouws E, *et al*. **Towards an improved investment approach for an effective response to HIV/AIDS.** *Lancet* 2011; **377**:2031–2041.
43. UNAIDS. *Methods for estimating HIV incidence: Epi Alert [Internet].* Geneva, Switzerland: UNAIDS; 2012.
44. UNAIDS. *Methodology – understanding the latest estimates [Internet].* Geneva, Switzerland: UNAIDS; 2010.
45. Stover J, Johnson P, Zaba B, Zwahlen M, Dabis F, Ekpini RE. **The Spectrum projection package: improvements in estimating mortality, ART needs, PMTCT impact and uncertainty bounds.** *Sex Transm Infect* 2008; **84 (Suppl 1)**:i24–i30.
46. Stover J, Johnson P, Hallett T, Marston M, Becquet R, Timaeus IM. **The Spectrum projection package: improvements in estimating incidence by age and sex, mother-to-child transmission, HIV progression in children and double orphans.** *Sex Transm Infect* 2010; **86 (Suppl 2)**:ii16–ii21.
47. Stover J, Brown T, Marston M. **Updates to the spectrum/estimation and projection package (EPP) model to estimate HIV trends for adults and children.** *Sex Transm Infect* 2012; **88 (Suppl 2)**:i11–i16.
48. UNAIDS Reference Group on Estimates, Modelling and Projections. *Consultation on estiamtes of mortality due to HIV/AIDS [Internet].* Geneva, Switzerland: UNAIDS; 2012.
49. Rajaratnam JK, Marcus JR, Levin-Rector A, Chalupka AN, Wang H, Dwyer L, *et al*. **Worldwide mortality in men and women aged 15-59 years from 1970 to 2010: a systematic analysis.** *Lancet* 2010; **375**:1704–1720.
50. Lozano R, Ortblad KF, Lopez AD, Murray CJ. **Mortality from HIV in the Global Burden of Disease study – authors' reply.** *Lancet* 2013; **381**:991–992.