



# Avoiding 40% of the premature deaths in each country, 2010–30: review of national mortality trends to help quantify the UN Sustainable Development Goal for health

Ole F Norheim, Prabhat Jha, Kesetebirhan Admasu, Tore Godal, Ryan J Hum, Margaret E Kruk, Octavio Gómez-Dantés, Colin D Mathers, Hongchao Pan, Jaime Sepúlveda, Wilson Suraweera, Stéphane Verguet, Addis T Woldemariam, Gavin Yamey, Dean T Jamison, Richard Peto



## Summary

**Background** The UN will formulate ambitious Sustainable Development Goals for 2030, including one for health. Feasible goals with some quantifiable, measurable targets can influence governments. We propose, as a quantitative health target, “Avoid in each country 40% of premature deaths (under-70 deaths that would be seen in the 2030 population at 2010 death rates), and improve health care at all ages”. Targeting overall mortality and improved health care ignores no modifiable cause of death, nor any cause of disability that is treatable (or also causes many deaths). 40% fewer premature deaths would be important in all countries, but implies very different priorities in different populations. Reinforcing this target for overall mortality in each country are four global subtargets for 2030: avoid two-thirds of child and maternal deaths; two-thirds of tuberculosis, HIV, and malaria deaths; a third of premature deaths from non-communicable diseases (NCDs); and a third of those from other causes (other communicable diseases, undernutrition, and injuries). These challenging subtargets would halve under-50 deaths, avoid a third of the (mainly NCD) deaths at ages 50–69 years, and so avoid 40% of under-70 deaths. To help assess feasibility, we review mortality rates and trends in the 25 most populous countries, in four country income groupings, and worldwide.

**Methods** UN sources yielded overall 1970–2010 mortality trends. WHO sources yielded cause-specific 2000–10 trends, standardised to country-specific 2030 populations; decreases per decade of 42% or 18% would yield 20-year reductions of two-thirds or a third.

**Results** Throughout the world, except in countries where the effects of HIV or political disturbances predominated, mortality decreased substantially from 1970–2010, particularly in childhood. From 2000–10, under-70 age-standardised mortality rates decreased 19% (with the low-income and lower-middle-income countries having the greatest absolute gains). The proportional decreases per decade (2000–10) were: 34% at ages 0–4 years; 17% at ages 5–49 years; 15% at ages 50–69 years; 30% for communicable, perinatal, maternal, or nutritional causes; 14% for NCDs; and 13% for injuries (accident, suicide, or homicide).

**Interpretation** Moderate acceleration of the 2000–10 proportional decreases in mortality could be feasible, achieving the targeted 2030 disease-specific reductions of two-thirds or a third. If achieved, these reductions avoid about 10 million of the 20 million deaths at ages 0–49 years that would be seen in 2030 at 2010 death rates, and about 17 million of the 41 million such deaths at ages 0–69 years. Such changes could be achievable by 2030, or soon afterwards, at least in areas free of war, other major effects of political disruption, or a major new epidemic.

**Funding** UK Medical Research Council, Norwegian Agency for Development Cooperation, Centre for Global Health Research, and Bill & Melinda Gates Foundation.

**Copyright** © Norheim et al. Open Access article distributed under the terms of CC BY-NC-SA.

## Introduction

The Millennium Development Goals (MDGs) for 2015, adopted actively by governments in 2000, have mobilised action on development issues.<sup>1–3</sup> During 2015, the UN will formulate 2016–30 Sustainable Development Goals, of which one (SDG3) will relate to health.<sup>1</sup> Some MDGs defined quantifiable targets that allowed progress to be assessed within regions and countries, such as MDG4 (reduce under-5 mortality from 1990 to 2015 by two-thirds) and MDG5 (reduce maternal mortality from 1990 to 2015 by three-quarters). Neither goal will be realised by 2015, although child and maternal mortality

will have approximately halved, but both have helped accelerate progress.<sup>4–8</sup> The MDGs successfully engaged national leaders, with progress toward the goals reviewed at annual summits. High-level policy makers have limited time, and their engagement was facilitated by some targets being quantifiable and (eventually) attainable.

The current draft of the 2016–30 SDGs includes 17 overarching goals;<sup>1</sup> 16 are not health goals, although they may affect health indirectly. The draft health goal, SDG3, is to “ensure healthy lives and promote well-being for all at all ages” (panel 1). Its 13 subtargets include

Published Online  
September 19, 2014  
[http://dx.doi.org/10.1016/S0140-6736\(14\)61591-9](http://dx.doi.org/10.1016/S0140-6736(14)61591-9)

See Online/Comment  
[http://dx.doi.org/10.1016/S0140-6736\(14\)61655-X](http://dx.doi.org/10.1016/S0140-6736(14)61655-X)

Department of Global Public Health and Primary Care, University of Bergen, Norway (Prof O F Norheim PhD); Centre for Global Health Research, St Michael's Hospital, University of Toronto, ON, Canada (Prof P Jha DPhil, W Suraweera MSc); Ministry of Health, Ethiopia (Minister K Admasu MD, A T Woldemariam MD); Ministry of Foreign Affairs, Oslo, Norway (T Godal MD); Centre for Global Engineering, University of Toronto, ON, Canada (R J Hum MEng); Mailman School of Public Health, Columbia University, New York, NY, USA (M E Kruk MD); National Institute of Public Health, Cuernavaca, Mexico (O Gómez-Dantés MD); WHO Mortality and Burden of Disease Unit, Geneva, Switzerland (C D Mathers PhD); Nuffield Department of Population Health Clinical Trial Service Unit & Epidemiological Studies Unit (CTSU), University of Oxford, Oxford, UK (Prof R Peto FRS, H Pan PhD); Global Health Sciences, University of California, San Francisco, USA (Prof D T Jamison PhD, Prof J Sepúlveda MD, G Yamey MD); and Department of Global Health, University of Washington, Seattle, USA (S Verguet PhD)

Correspondence to:  
Prof O Norheim, Department of Global Public Health and Primary Care, University of Bergen, PB 7800, 5020 Bergen, Norway  
[Ole.norheim@igs.uib.no](mailto:Ole.norheim@igs.uib.no)

or  
Prof R Peto, CTSU, Richard Doll Building, Oxford OX3 7LF, UK  
[RPeto@ctsu.ox.ac.uk](mailto:RPeto@ctsu.ox.ac.uk)

two numerical ones that might be achievable (if current progress improves): about two-thirds less maternal mortality and a third less non-communicable disease (NCD) mortality. They also include, however, ending preventable newborn and under-5 deaths; ending HIV/AIDS, tuberculosis, malaria, and neglected tropical diseases; substantially reducing death and illness from pollution; halving traffic deaths (which are currently increasing); universal access to sexual and reproductive services; and universal health coverage, with financial risk protection.

Although a few such aspirations would by 2015 have been replaced in the final SDG3 by feasible 2030 targets, there are drawbacks to retaining any implausible ones.<sup>15</sup> An alternative is to accompany SDG3 by an overarching numerical target that could with serious extra effort be feasible (by 2030 or the 2030s), stimulating sustainable progress and potentially attracting endorsement from all governments, despite their differing economic and health circumstances.

Global life expectancy is now (2010) about 70 years. We have defined premature death somewhat arbitrarily as death before age 70 years, but considered mortality in the three age ranges 0–4, 5–49, and 50–69 years largely separately, since the predominant causes differ between them. We have also considered different countries separately, since the predominant causes (and available resources) vary greatly between countries. But, all countries share an appreciable risk of death before age 70 years, reduction of which could be an appropriate quantitative target. Subtargets could concern particular causes of death, but an overarching universal target for all countries should include potentially feasible reductions in premature death as a whole.

Based on recent trends, this target could be: “Avoid 40% of all premature deaths in each country (ie, of the deaths before 70 years that would be seen in its 2030 population if its 2010 death rates persisted—which they will not, since mortality is already generally decreasing), and improve health care at all ages”. This paper is mainly about the first part of this target (avoid 40% of

#### Panel 1: Post-2015 global health goals<sup>1,9–14</sup>

A UN intergovernmental Open Working Group (OWG), established following the 2012 UN Sustainable Development Conference, is drafting 2016–30 SDGs. One overarching goal will be health-related, SDG3, and various UN initiatives have discussed what it and its subtargets could be:

##### High-Level Panel of Eminent Persons

This panel, chaired by the Indonesian, Liberian, and UK premiers, recommended for SDG3 “To ensure healthy lives”, with five targets: under-5 mortality  $\leq 2\%$  in all income quintiles, plus non-numerical targets on vaccination coverage; maternal deaths; sexual and reproductive health and rights; and HIV/AIDS, tuberculosis, malaria, NTDs and priority NCDs.

##### The Sustainable Development Solutions Network

Initiated by economist Jeffrey Sachs, it recommended “Health and wellbeing at all ages”, with three numerical targets: under-5 mortality  $\leq 2\%$ ; maternal mortality  $\leq 40$  deaths per 100 000 livebirths; and under-70 NCD mortality reduced by  $\geq 30\%$ .

##### The UN Global Compact

This group, involving businesses in global development, proposed two targets for 2010–30: maternal mortality reduced by 75%; and under-5 mortality reduced by 67%.

##### Global Thematic Consultation on Post-2015 Health Agenda

After wide consultation (100 submitted papers and 14 international hearings with 1600 participants), it recommended: build on and accelerate the MDG agenda, reduce the NCD burden, and ensure universal health coverage and access.

##### UNICEF’s Promise Renewed

UNICEF proposed each country commit to scale up high-impact strategies to make 2035 under-5 mortality  $\leq 2\%$ .

##### The WHO World Health Assembly NCD Resolution

This resolution targeted reducing premature death from NCDs (ie, the uniformly age-standardised mortality rates at ages 30–69 years) by 25% from 2010 to 2025.

##### The Lancet Commission on Investing in Health (not UN)

Chaired by economists Lawrence Summers and Dean Jamison, it proposed that health-system strengthening plus scale-up of proven, affordable health interventions and suitable research and development could achieve a “grand convergence in global health by 2035”—reducing infectious, maternal, and child deaths in low or lower-middle income countries to current best levels in middle-income countries. 2030 targets for such countries are: under-5 mortality  $\leq 2\%$  (neonatal mortality  $\leq 1.1\%$ ); maternal deaths  $\leq 94$  per 100 000 livebirths; and annual mortality per 100 000  $\leq 4$  for tuberculosis and  $\leq 3$  for AIDS.

##### The July 2014 OWG proposal for SDG3

The proposal to “ensure healthy lives and promote wellbeing for all at all ages” had 13 subtargets: maternal mortality  $\leq 70$  deaths per 100 000 livebirths; end preventable newborn and under-5 deaths; end the epidemics of HIV/AIDS, tuberculosis, malaria, NTDs, and other infections; reduce premature NCD mortality by a third; halve traffic accident morbidity and mortality; strengthen treatment and prevention of substance abuse; universal access to sexual and reproductive health services; substantially reduce morbidity and mortality from air, water, and soil pollution; strengthen tobacco control and capacity to tackle health risks; support health research and development; finance health workforces; achieve universal health coverage with financial risk protection.

SDG=Sustainable Development Goals. NTDs=neglected tropical diseases. NCDs=non-communicable diseases.

premature deaths), which could be universal. For the second part (improve health care), the targets would have to be appropriately country-specific.

40% fewer premature deaths would be important even in high-income, low-mortality countries, but the absolute gain from it would be greater in countries with higher death rates.

Substantial reductions in premature death can be achieved everywhere (and, importantly, could be monitored in many populations).<sup>16–18</sup> Placing the main emphasis on premature death and improved health care does not ignore disability, since many causes of disability are treatable, or are also important causes of death (and the main contributor to international variation in composite indices of death and disability, especially in lower-income countries, is premature death<sup>19</sup>).

Changes that reduce mortality in middle age also benefit older people (>70 years), since the main causes of death and disability at 50–69 years are similar to those at somewhat older ages. Moreover, strategies for reducing adult and, particularly, child mortality should also include wider availability of affordable, cost-effective health care, including mental health and sexual, reproductive, and perinatal health services.

From targeting premature death as a whole, appropriate national and regional risk-reduction priorities follow. These priorities vary from one country to another, depending on current mortality rates from various diseases and from injuries and the costs of effective action to reduce those rates, leading to population-specific prioritisation of appropriate diseases and age groups.<sup>20,21</sup>

Moreover, targeting premature death could establish a political precedent whose effects continue after 2030. This political precedent matters, since even if premature death decreases 40% by around 2030, 60% would remain to be dealt with later. Substantial further gains follow if appropriate priorities are adopted over the next decade or two. Effective programmes to reduce particular causes of death or expand access to health care take many years to establish but, once established, can be continued.

Although many premature deaths result from other causes, most are caused by NCDs. Some interventions can affect NCD mortality quite quickly (eg, treatment availability), but others take decades. For example, although adult smoking cessation produces fairly rapid benefits, reducing uptake rates produces major benefits only after many decades,<sup>22</sup> as does childhood vaccination against hepatitis B and papillomavirus to avoid liver and cervix cancer. For governments to value such measures appropriately, long-term targeting of premature death should be institutionalised within them, reducing 2030 mortality and laying foundations for substantial further reductions after 2030, when today's children and young adults will be passing through middle age.

If targets are to be pursued seriously, progress towards them needs to be monitored. For premature death this monitoring requires trends only in under-70 mortality

(which are easier to monitor reliably than trends at older ages). Monitoring targets that involve expected life-years lost (or disability-adjusted life-years lost<sup>23,24</sup>) from particular causes, or overall life expectancy (or healthy life expectancy) require trends in mortality rates at older ages (and disability rates), so in many countries progress would be difficult or impossible to monitor reliably. Moreover, where life expectancy is already over 75 years, increasing it might be perceived as less interesting than reducing premature death. For robustness of measure and simplicity of communication, therefore, we shall, as the International Epidemiological Association recommended,<sup>25</sup> chiefly emphasise all-cause mortality rates, although at all ages health care and good health, including mental health,<sup>26</sup> also matter.

Except where HIV or war or other major political disturbances predominate, health and longevity are better now than they were 20, 40, or more years ago, and still improving. But, there are still many deaths before old age. Our analyses assess the substantial reductions in all-cause mortality from 1970 to 2010, the more recent changes in cause-specific mortality from 2000 to 2010, and the main remaining causes of death. In view of these mortality trends and levels, we consider what further reductions in premature death could be feasible by 2030, if its reduction was prioritised. We conclude that an ambitious but possibly realistic overarching target for 2030 is to avoid 40% of the premature deaths in every country where mortality in 2030 is not dominated by new epidemics, disturbances, or disasters.

Turning from national to global targets, a cost-effective way to reduce premature death in many countries is to continue reducing child and maternal mortality, tuberculosis, HIV, and malaria, partly because programmes for these reductions that took years to establish are already in place, and death rates are decreasing.<sup>4–8,27</sup> For these particular causes we propose subtargets of a reduction by two-thirds in global deaths in 2030, compared with numbers expected at 2010 death rates. This would require moderate further acceleration of current progress, which would require better health care and substantial political effort.

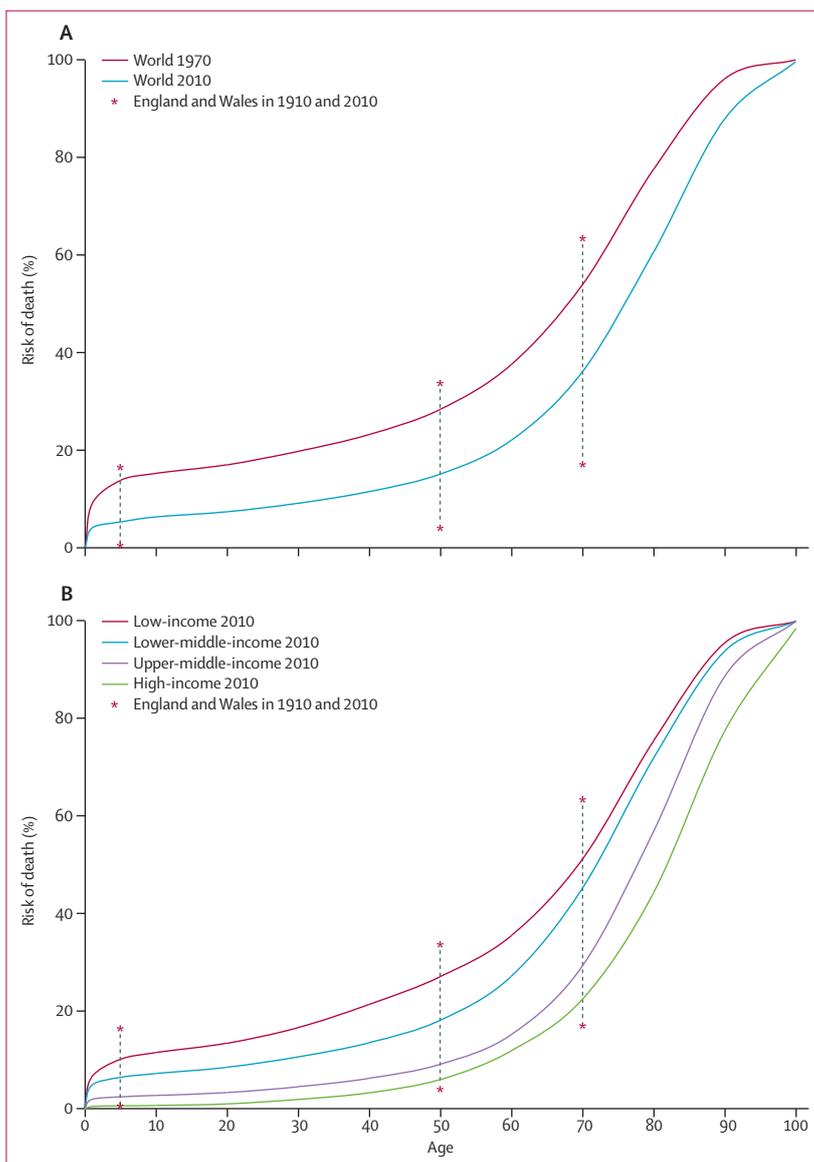
We also propose, based on the World Health Assembly resolution on under-70 mortality from NCDs,<sup>28</sup> subtargets of a reduction by a third in the global number of premature deaths not only from NCDs but also from the remaining causes at ages 5–69 years (other communicable diseases and injuries). These reductions by a third would again require substantial programmes, different for different diseases (and for fatal accidents), to accelerate current rates of progress moderately.

If achieved, these subtargets would halve under-50 mortality, reduce global deaths at 50–69 years by about a third (mostly by reducing NCDs), and hence reduce under-70 mortality by about 40%. Before further discussion, we review recent and current global and national mortality levels and trends.

## Methods

Many populations lack vital registration (and things were worse in past decades), so mortality trend estimates for them are approximate. We used UN-based mortality estimates (which should suffice for our main purposes) to assess trends, but we also cite other sources. To estimate overall mortality rates and trends for the whole world; for the four World Bank income-based country groupings; for the 25 most populous countries (which include 75% of global 2010 population); and for the 164 countries with projected 2030 population greater than 1 million (appendix

See Online for appendix



**Figure 1: Risk of death versus age for the world in 1970 and 2010 (A) and for country income groupings in 2010 (B)**

(A) Risk of death versus age for world in 1970 and in 2010. (B) Risk of death versus age for low-income, lower-middle-income, upper-middle-income, and high-income countries in 2010. Results for both sexes are combined; appendix p 3 gives sex-specific results. 1970 risk is the mean of 1965–70 and 1970–75 risks, and the risk of 2010 is the mean of 2005–10 and projected 2010–15 risks. For historical comparison, the 1910 and 2010 risks for England and Wales are given.

pp 10–13), we chiefly used UN Population Division (UNPD) historical life tables.<sup>29</sup> These cover each five-year time period from 1950 to 2010, with medium-fertility projections for 2010–15. For every fifth year from 1970 to 2010, we estimated the death rates in it by averaging the age-specific risks in the 5-year periods before and after it (so our 1970 rates describe risks in 1965–75); this method smooths out any sudden mortality changes. For global under-5 mortality, we also cite the (broadly similar) estimates from the UN Inter-Agency working group.<sup>6</sup> Results for both sexes are combined, but the appendix gives sex-specific data.

From the historical life tables, we extracted for particular calendar years (1970–2010) the risks in the age ranges 0–4, 5–49, or 50–69 years, defining risk as the probability that someone who survived to the start of an age range dies in it. Although our main interest is in under-70 mortality, to describe approximate patterns of mortality up to age 100 years we took the death rates at 85–89, 90–94, and 95–99 years as the rate in the previous age group multiplied by the ratio of the rate at 80–84 to that at 75–79 years.

Cause-specific mortality rates for 2000 and 2010 for the world as a whole and for each of the four World Bank income groupings (appendix pp 14–17) were from the WHO Global Health Observatory.<sup>30</sup> Application of these 2000 and 2010 rates to the UNPD medium-fertility projection of the 2030 population yielded two numbers of deaths, comparison of which gave the change (% per decade); this is also the change in the death rate from 2000 to 2010, if standardised to the projected 2030 population being analysed. Such age-standardised comparisons avoid issues of competing risks.

## Role of the funding source:

The funders had no role in study design, data collection, analysis interpretation, or writing of the report. OFN, PJ, and RP had full access to all data. OFN and RP had final responsibility for submitting for publication.

## Results

Between 1970 and 2010, mortality decreased substantially, particularly in young children (figure 1A). From 1970 to 2010, under-5 mortality fell by almost two-thirds (from 14% to 5%, absolute difference 9%), under-50 mortality almost halved (from 28% to 15%, absolute difference 13%), and under-70 mortality fell by a third (54% to 36%, absolute difference 18%).

The World Bank groups countries as low, lower-middle, upper-middle, and high income.<sup>31</sup> Figure 1B describes 2010 mortality in these four groups, showing the excess premature mortality in lower-income countries (although even they now have lower mortality than the world as a whole in 1970).

With regard to mortality changes by age group between 1970 and 2010, the trends at 0–4 and 50–69 years were uniformly favourable, but the generally favourable trend at 5–49 years was slowed in the 1990s (and, in low-income countries, temporarily reversed) by HIV (figure 2).

The absolute 1970–2010 reductions in risk of death at ages 0–4 and 5–49 years were much steeper in low-income than in high-income countries. Still, however, substantial risk remains in low-income countries (low-income *vs* high-income risks: 10% *vs* <1% at 0–4 years and 18% *vs* 6% at 5–49 years). The risk of a person aged 50 years dying at ages 50–69 years decreased by a third (from 36% in 1970 to 24% in 2010), with similar absolute risk reductions in low-income and high-income countries.

Within each income group, different countries had different mortality patterns. Figures 3 and 4 show the 1970–2010 trends in risk at 0–4, 5–49, 50–69, 0–49, and 0–69 years in the 25 most populous countries, which include 75% of 2010 world population. The appendix (pp 6–9) gives separate results for male and female mortality rates, which differed little at 0–4 years but showed some sharp contrasts at older ages. Risks and trends are somewhat untrustworthy for countries without vital statistics, but nevertheless differences between countries are remarkable, as is the general decrease in mortality within each age range, except in the few countries where special factors (HIV, war, or vodka) supervened.

Figure 3A shows trends at 0–4 years. By 2010, there was a more than 50-fold variation in risk, from 18% in DR Congo to 0.3% in Japan and western Europe. War and political disruption affected 1970 (ie, 1965–75) risks in Bangladesh, China, DR Congo, Ethiopia, Nigeria, South Africa, and Vietnam. Over the past 20 years, however (apart from South Africa, where HIV supervened, and DR Congo, where political disruption supervened), the proportional decreases in under-5 mortality were substantial everywhere, with striking absolute reductions ( $\geq 15\%$ ) in Bangladesh, Egypt, Ethiopia, Iran, and Turkey. Since most under-5 deaths were in south Asia and sub-Saharan Africa, worldwide trends depend mainly on these regions.

Figure 3B shows trends at 5–49 years. By 2010, we noted a 10-fold variation, from nearly 40% in South Africa (where HIV predominates) to 4% in Japan and western Europe. There was a general decrease, except in South Africa and Russia. HIV caused the extreme South African fluctuation, and the fluctuation in Thailand.<sup>27</sup> The extreme Iranian fluctuation reflects 1980s war deaths, and the Russian pattern reflects mortality from spirits (decreasing since 2005 [appendix p 19], but still substantial).<sup>32</sup>

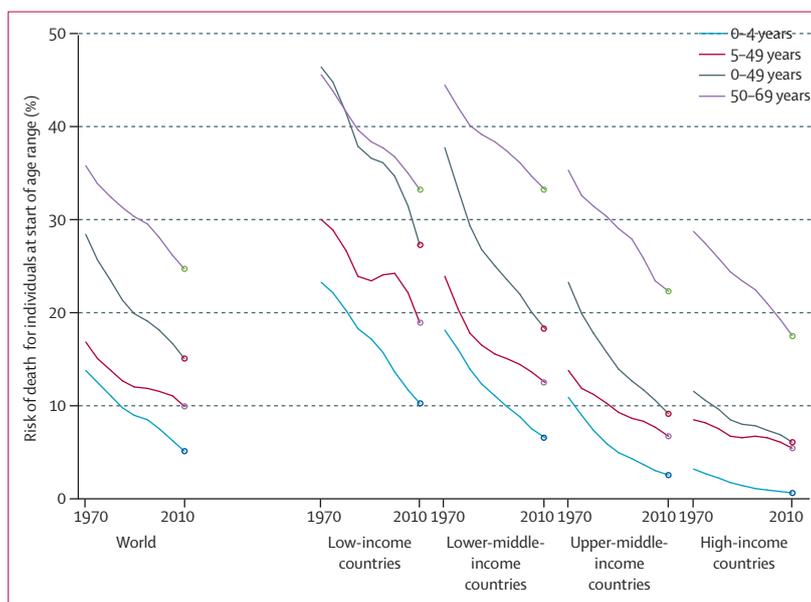
Figure 4A shows trends in the risk of a 50-year-old dying at 50–69 years. By 2010, we noted four-fold variation, with the highest rates in sub-Saharan Africa and Russia. Elsewhere, risk decreased. The decreases were slight in three countries (Philippines, Egypt, and Pakistan) and largest in Iran. In several high-income countries the risk halved during 1970–2010, helped since 1990 by reductions in tobacco deaths in the USA and Europe (appendix p 20–21).

Finally, figure 4B combines the foregoing trends at ages 0–4, 5–49, and 50–69 years to contrast the trends in

under-50 mortality and in under-70 mortality. In 2010, under-70 mortality varied from two-thirds in sub-Saharan Africa (similar to England in 1910; figure 1) to only 14% in Japan and Italy. Where risks are high, however, under-70 mortality can obscure trends; eg, in South Africa and Iran the fluctuations due to HIV or war are notably less extreme at 0–69 years than at 0–49 years.

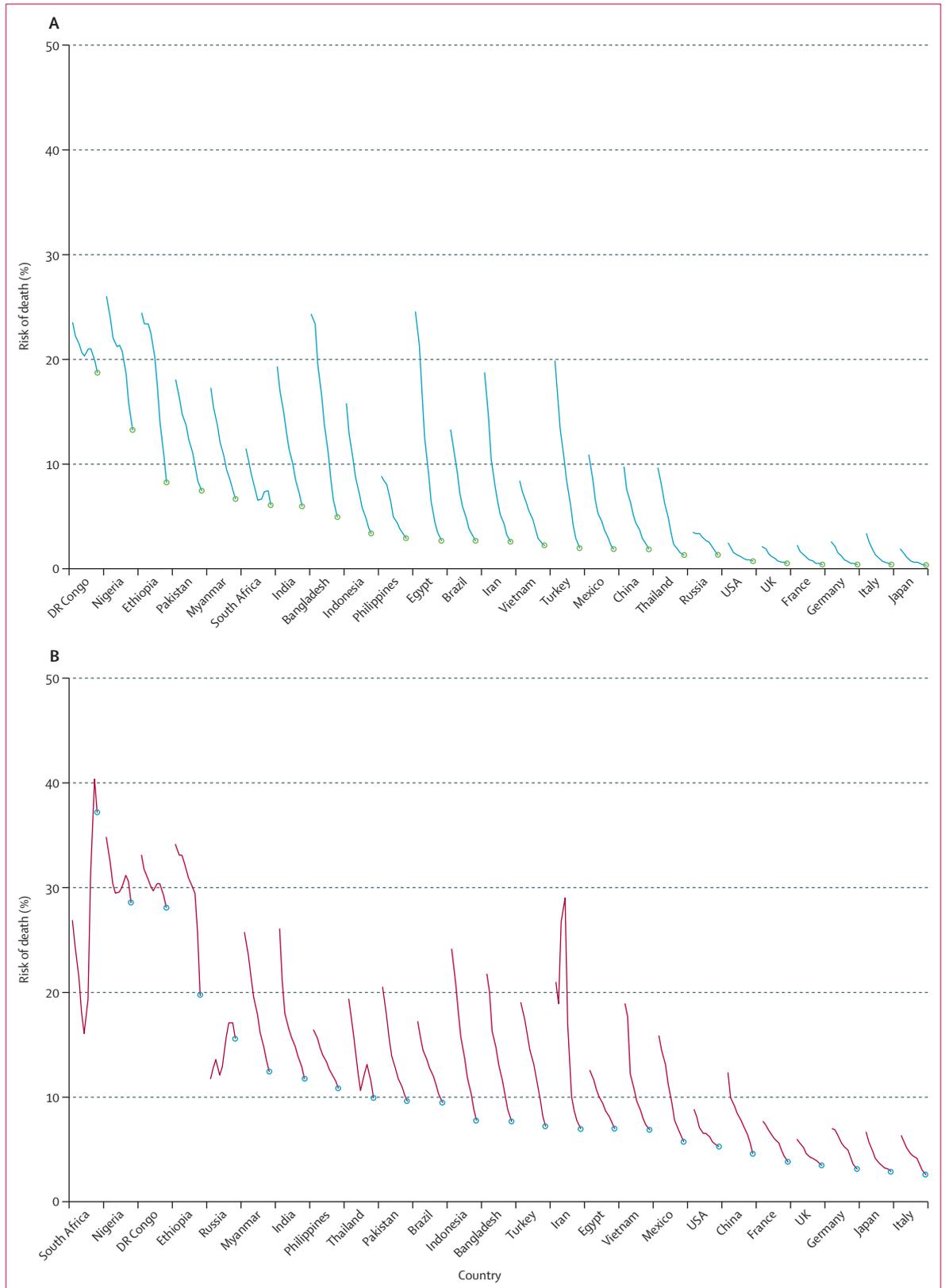
Trends during the past 10 years (2000–10) reflect more recent circumstances (and are unaffected by the large increase in HIV mortality before 2000, which ceased). Table 1 gives numbers of deaths at 0–4, 5–49, and 50–69 years expected in each country, or group of countries, in 2030 if its 2010 mortality rates still applied to its 2030 population. Death rates are falling, however, so numbers actually seen in 2030 will be lower. Hence, it also gives the change in mortality rates (% per decade) from 2000 to 2010. If such changes continue for another 20 years, deaths in 2030 would be reduced by almost twice the change per decade (final column of table 1; decreases per decade of 18% or 42% yield 20-year reductions of a third or two-thirds). Results are given separately for the world, four World Bank income groups, the EU, the 25 most populous countries (sorted by 2030 death numbers), and 164 countries with a population of more than 1 million (appendix pp 10–13).

Worldwide in 2030, 41 million premature deaths would be expected at 2010 death rates (7, 12, and 22 million at 0–4, 5–49, and 50–69 years). These numbers would be slightly increased by stratification

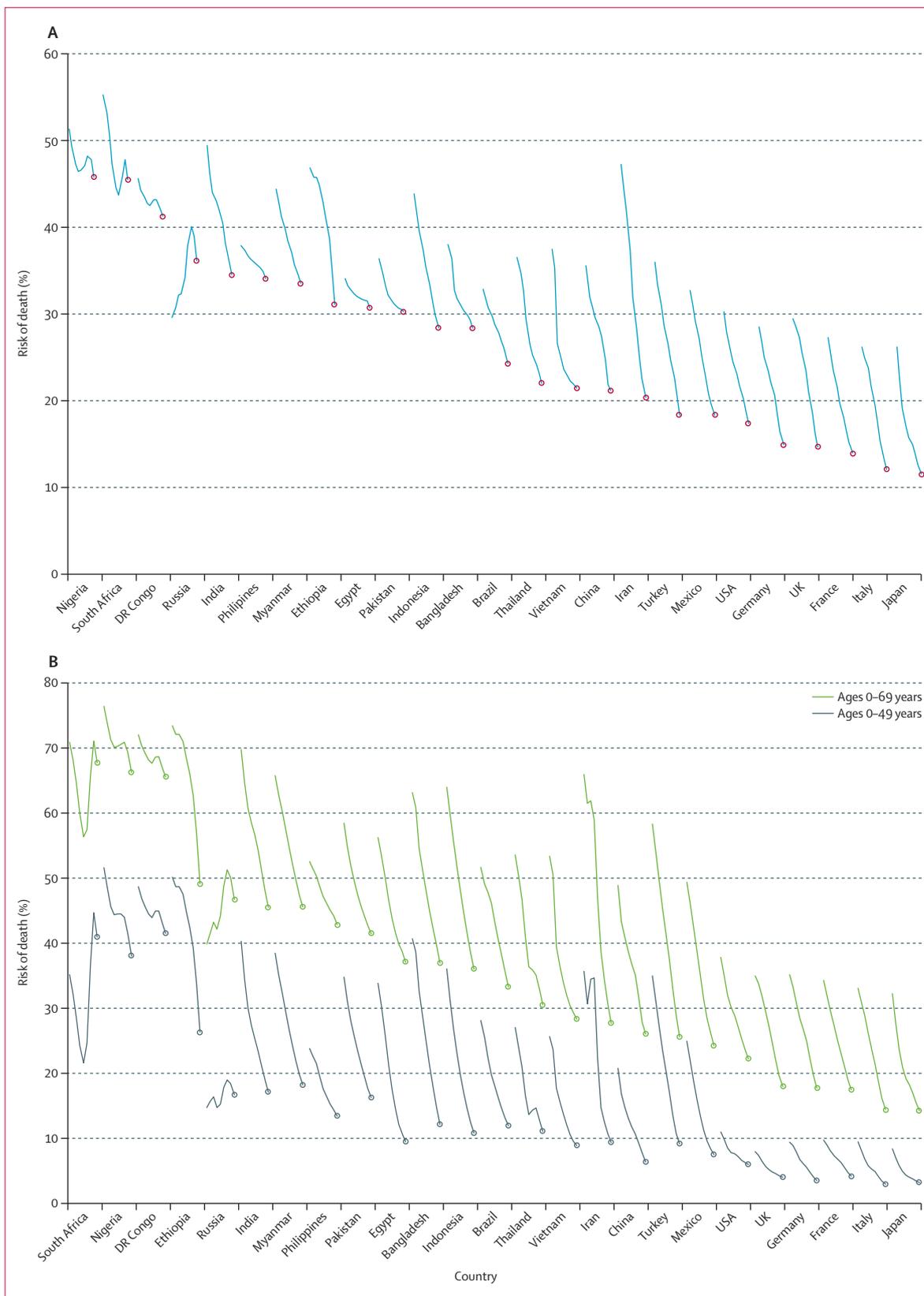


**Figure 2:** 40-year trends, 1970–2010, in risks of dying in selected age ranges for the world (left), and (right) four World Bank groupings of countries (low-income to high-income)

Risks are for those who have already survived to the start of the relevant age range. Results for both sexes are combined; appendix p 5 gives sex-specific results. Risks average previous and subsequent 5-year time periods (so 1970 risk is the mean of 1965–70 and 1970–75 risks; 2010 risk is the mean of 2005–10 risks and UNPD projection for the 2010–15 risks), smoothing any sudden changes. Details of these graphs are tabulated in the appendix (pp 25–26). 2 billion deaths at ages 0–69 years were recorded from 1965 to 2010.



**Figure 3: 40-year trend lines, 1970–2010, for 25 most populous countries in risks of dying in selected age ranges** (A) Risk of death at ages 0–4 years. (B) Risk, at age 5 years, of death at ages 5–49 years. Results for both sexes are combined; appendix pp 6–7 give sex-specific results. Risks average the previous and subsequent 5-year time periods (so the 1970 risk is the mean of the 1965–70 and 1970–75 risks), smoothing any sudden changes.



**Figure 4:** 40-year trend lines, 1970–2010, for 25 most populous countries in risks of dying in selected age ranges (A) Risk, at age 50 years, of death at ages 50–69 years. (B) Risks, ages 0–49 years and 0–69 years. Results for both sexes are combined; appendix pp 8–9 give sex-specific results. Risks average the previous and subsequent 5-year time periods (so the 1970 risk is the mean of the 1965–70 and 1970–75 risks), smoothing any sudden changes.

by country income group (table 1). In 2000–10, under-5 mortality decreased by about a third per decade and mortality at 5–49 and 50–69 years decreased by about a sixth per decade. If similar decreases per decade continue (which they might not, without substantial effort), this would reduce 2030 under-70 deaths by about a third, to 27 million (3 million at 0–4 years, 8 million at 5–49 years, and 16 million at 50–69 years).

In low-income countries the proportion of premature deaths that are in childhood is still substantial, so a substantial absolute reduction in premature death is still possible. India, China, Nigeria, and Indonesia account for 20 million of the 41 million premature deaths in table 1; all are currently on track for a 2010–30 reduction of about a third (ie, 18% per decade). Next in absolute numbers of premature deaths are DR Congo and Pakistan, with

	Age 0–4		Age 5–49		Age 50–69		Age 0–69		(Implied % change per 20 years†)
	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	
Most populous 25 countries‡									
2 India	1.49	–30%	2.72	–15%	5.05	–12%	9.26	–17	(–31%)
3 China	0.28	–36%	0.92	–30%	4.71	–15%	5.91	–19	(–34%)
1 Nigeria	1.36	–31%	1.30	–12%	0.63	–7%	3.29	–20	(–37%)
2 Indonesia	0.14	–37%	0.34	–25%	0.95	–10%	1.42	–17	(–32%)
1 DR Congo	0.72	–13%	0.50	–11%	0.21	–7%	1.42	–12	(–22%)
2 Pakistan	0.34	–22%	0.34	–14%	0.52	–2%	1.20	–12	(–22%)
3 Russia	0.02	–46%	0.33	–7%	0.77	–11%	1.12	–11	(–21%)
3 Brazil	0.07	–30%	0.32	–17%	0.66	–15%	1.05	–16	(–30%)
4 USA	0.04	–12%	0.25	–9%	0.76	–18%	1.04	–15	(–28%)
1 Ethiopia	0.30	–43%	0.43	–38%	0.22	–25%	0.95	–37	(–61%)
1 Bangladesh	0.14	–44%	0.22	–27%	0.51	–4%	0.86	–19	(–35%)
3 South Africa	0.06	–21%	0.39	22%	0.24	–1%	0.70	+8	..
2 Philippines	0.08	–24%	0.20	–10%	0.35	–4%	0.63	–9	(–17%)
3 Mexico	0.04	–36%	0.12	–17%	0.27	–15%	0.43	–18	(–33%)
2 Egypt	0.05	–38%	0.11	–17%	0.28	–4%	0.43	–13	(–24%)
2 Vietnam	0.02	–30%	0.11	–11%	0.28	–1%	0.41	–6	(–11%)
1 Myanmar	0.05	–20%	0.12	–15%	0.24	–7%	0.41	–12	(–22%)
3 Thailand	0.01	–33%	0.09	–24%	0.25	–8%	0.34	–14	(–26%)
3 Iran	0.03	–39%	0.10	–20%	0.20	–20%	0.33	–22	(–39%)
3 Turkey	0.02	–53%	0.09	–26%	0.17	–19%	0.29	–26	(–45%)
4 Japan	<0.01	–29%	0.04	–15%	0.19	–18%	0.24	–18	(–32%)
4 Germany	<0.01	–23%	0.03	–27%	0.20	–20%	0.23	–21	(–38%)
4 UK	<0.01	–20%	0.03	–14%	0.13	–23%	0.17	–22	(–38%)
4 France	<0.01	–26%	0.03	–25%	0.12	–17%	0.16	–19	(–34%)
4 Italy	<0.01	–38%	0.02	–30%	0.12	–23%	0.14	–24	(–43%)
Total, 25 most populous countries	5.3	–30%	9.2	–17%	18.0	–13%	32.4	–17	(–32%)
European Union§	0.03	–30%	0.25	–22%	1.2	–19%	1.5	–20	(–36%)
World Bank grouping									
1 Low-income	3.0	–34%	3.9	–22%	2.7	–12%	9.6	–24	(–43%)
2 Lower-middle	3.9	–31%	6.3	–11%	9.4	–10%	19.6	–16	(–29%)
3 Upper-middle	0.6	–43%	2.8	–20%	8.2	–20%	11.6	–22	(–38%)
4 High-income	0.1	–26%	0.6	–16%	2.4	–15%	3.1	–15	(–28%)
Total, four World Bank groupings	7.6	..	13.6	..	22.7	..	43.9	..	..
World, at global mortality rates¶	7.2	–34%	12.4	–17%	21.7	–15%	41.3	–19	(–35%)

\*The death rates of exact year 2000 and the (lower) death rates of exact 2010 were applied to the 2030 population (UNPD medium-variant projection), yielding 2 numbers of 2030 deaths; change (% per decade) compares them. This change is identical to the change in the age-standardised death rate from 2000 to 2010, if both rates are standardised to the age distribution of the relevant 2030 population. †Change (%) over 20 years (2010–30) if the rate of change (% per decade) during 2000–10 were to continue. ‡Country name, and World Bank income grouping: 1=low, 2=lower-middle, 3=upper-middle, 4=high income. §All 28 states that were EU members in 2010, regardless of their status in the year 2000. ¶No allowance for population changes in income distribution, so numbers lower than totals for the 4 World Bank groups.

**Table 1: 25 most populous countries, and various groupings of countries: numbers of premature deaths in 2030 by age (years), if 2010 rates applied to 2030 populations, and current rate of change (% per decade, 2000–10) in age-standardised death rates**

political disruption and shallower rates of decline, Russia, where much premature mortality is from vodka consumption and tobacco use (hence avoidable), and the USA and Brazil, where current trends suggest 20-year decreases nearer 30% than 40%. The greatest decrease was in Ethiopia, and the only increase was in South Africa. In sub-Saharan Africa, large reductions in premature death would be possible with political stability and HIV control.

Some causes of death are much more susceptible to control than others. Table 2 breaks down the global numbers by cause and age; the appendix (pp 14–18)

shows these data for each income group. The age distributions of different causes help explain why rates of decrease are steeper at 0–49 years than at 50–69 years. In the subtotals (table 2; table 3), projected deaths in 2030 from communicable, neonatal, maternal, and nutritional causes number 10 million at 0–49 years and 2 million at 50–69 years. By contrast, those from non-communicable diseases number 6 million at 0–49 years and 18 million at 50–69 years. As rates of decrease are twice as great for communicable disease as for other causes, under-50 mortality is falling particularly rapidly.

	Age 0–49		Age 50–69		Age 0–69		(Age ≥70)
	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions
<b>Communicable, perinatal, maternal, or nutritional</b>							
Neonatal†	2.6	-23%	..	..	2.6	-23%	..
Respiratory infection	1.5	-35%	0.7	-17%	2.2	-31%	(2.2)
HIV/AIDS	1.7	-14%	0.3	-19%	2.0	-15%	(0.0)
Diarrhoea	1.1	-40%	0.4	-25%	1.5	-37%	(0.6)
Tuberculosis	0.5	-39%	0.6	-41%	1.0	-40%	(0.5)
Malaria	0.6	-30%	<0.1	-19%	0.7	-30%	(0.0)
Nutritional deficiencies	0.4	-24%	0.1	-28%	0.5	-24%	(0.3)
Meningitis	0.4	-29%	0.1	-13%	0.4	-27%	(0.1)
Childhood cluster‡	0.3	-67%	..	..	0.3	-67%	..
Maternal	0.3	-37%	..	..	0.3	-37%	..
Other communicable	0.8	-22%	0.4	-8%	1.1	-18%	(0.5)
<b>Non-communicable diseases</b>							
Vascular or diabetic	1.8	-17%	8.4	-16%	10.1	-17%	(21.1)
Neoplastic	1.4	-14%	5.0	-9%	6.4	-10%	(6.8)
Chronic respiratory	0.3	-30%	1.7	-28%	2.0	-28%	(4.8)
Cirrhotic	0.3	-14%	0.8	-11%	1.1	-12%	(0.4)
Other digestive	0.3	-21%	0.6	-19%	0.9	-20%	(1.1)
Renal	0.3	-14%	0.5	-2%	0.8	-7%	(1.0)
Congenital	0.6	-11%	..	..	0.6	-11%	(0.0)
Other non-communicable	0.7	+3%	0.7	+12%	1.4	+7%	(2.0)
<b>Injuries</b>							
Non-road-traffic accidents	1.7	-17%	0.8	-8%	2.4	-14%	(1.2)
Road traffic accidents	1.0	+2%	0.4	+15%	1.4	+5%	(0.3)
Suicide	0.6	-23%	0.3	-25%	0.9	-24%	(0.2)
Homicide or war	0.5	-20%	0.1	-29%	0.6	-22%	(0.0)
<b>Subtotals: cause categories</b>							
Communicable, perinatal, maternal or nutritional	10.2	-31%	2.6	-25%	12.8	-30%	(4.1)
Non-communicable diseases	5.8	-15%	17.5	-14%	23.3	-14%	(37.2)
Injuries	3.6	-14%	1.6	-9%	5.2	-13%	(1.7)
World total: All causes	19.6	-24%	21.7	-15%	41.3	-19%	(43.0)

\*The death rates of exact 2000 and the (lower) death rates of exact 2010 were applied to the 2030 population (UNPD medium-variant projection), yielding two numbers of 2030 deaths; change (% per decade) compares them. NB: This change is identical to the change the age-standardised death rate from 2000 to 2010, if both rates are standardised to the age distribution of the world population in 2030. †Conditions arising in the perinatal period (ICD-10 P00–P96); mostly avoidable. NB: Excludes congenital malformations. ‡Diphtheria, pertussis, tetanus, poliomyelitis, measles; all are vaccine-preventable.

**Table 2: Worldwide numbers of premature deaths by cause and age (years) in 2030, if 2010 rates applied to 2030 world population, and current rate of change (% per decade, 2000–10\*) in age-standardised death rates**

	Age 0–4	Age 5–49	Age 50–69
Neonatal or maternal	·/2·5	0·2/0·3	·
HIV	·/0·1	1·0/1·5	0·2/ 0·3
TB and malaria	·/0·5	0·3/0·5	0·4/ 0·7
Other communicable*	·/2·8	0·6/1·9	0·5/ 1·6
Non-communicable†	·/0·9	1·6/4·9	5·8/17·5
Fatal injuries‡	·/0·4	1·1/3·3	0·5/1·6
All deaths, by age§	4·8/7·2	4·9/12·4	7·5/21·7
Cumulative deaths, starting from birth	·	Ages 0–49: 9·7/19·6	Ages 0–69: 17·3/41·3

Data are targeted reduction/number at 2010 rates. \*Includes malnutrition, but, mostly pneumonia and diarrhoea (before and after age 5 years). †At ages 0–4 years, most NCD deaths are from congenital disease. ‡Most fatal injuries are accidents, rather than suicide or homicide. §All deaths, by summation over four income-based groups of countries: ages 0–4 years, 5·0 million/7·6 million; ages 5–49 years, 5·4 million/13·6 million; ages 50–69 years, 8·1 million/22·7 million. Target of two-thirds reduction in under-5 mortality as a whole is not subdivided by cause.

**Table 3: Premature deaths (million) in 2030 population at unaltered 2010 death rates, and targeted reductions that would be avoided by reductions of two-thirds in child, maternal, tuberculosis, HIV, and malaria deaths, and of a third in other deaths**

Subdividing further, there was no material increase from 2000 to 2010 in any major cause except traffic accidents. Mortality from communicable diseases decreased rapidly (except that HIV rose for a few years, then fell). Mortality from non-communicable diseases decreased moderately (except that chronic respiratory disease decreased rapidly). Mortality decreased more slowly from injuries than from disease; although suicide and homicide (which includes war deaths) decreased, increased traffic deaths were only just outweighed by decreases in other fatal accidents.

For some populations, striking trends in all-cause, cancer or vascular mortality (appendix pp 19–24) illustrate vividly the importance of particular factors—HIV, tobacco, alcohol, vascular medication, or under-5 mortality. Where death rates remain high, substantial absolute risk reductions are possible.

## Discussion

In old age death is inevitable, but death before old age is not.<sup>33</sup> World life expectancy is now just over 70 years, and most deaths before that age are avoidable. In some countries with reliable data, under-50 mortality is lower than 5%, under-70 mortality is lower than 20%, and both are still falling. In many countries, however, substantial risks remain, and there are substantial unmet health-care needs. Mortality and morbidity can be combined into composite indices such as healthy life expectancy (HALE) or disability-adjusted life-years (DALYs), but such indices are difficult to monitor in low-resource environments, and correlate closely with premature death.<sup>19,34</sup>

Even mortality rates and trends are not known exactly (as many high-mortality countries lack reliable vital statistics), and our estimates of them, based only on UN

and WHO statistics, could be made somewhat more reliable by seeking further evidence.<sup>4–8,35,36</sup> The present evidence is, however, reliable enough to help formulate reasonable mortality reduction targets. Generally, mortality rates have been falling for decades, particularly in childhood, despite sharp fluctuations in some populations due to HIV or direct or indirect effects of political disruption. Both the 40-year trends in figures 1–4 and the 10-year trends in tables 1–2 are of interest. We noted a larger decrease during 2000–10 than in the 1990s, due partly in the past few years to efforts to achieve the MDGs,<sup>4–8,27,37</sup> and our proposed targets (panel 2) build on the progress already being achieved.

Still, however, malaria, HIV, tuberculosis, and maternal and child mortality would, at 2010 death rates, cause about 9 million deaths in 2030 (7 million at 0–4 years plus 2 million at 5–49 years, out of a total of about 20 million under-50 deaths; table 3). If existing efforts to control them and expand health care are intensified in epidemiologically efficient ways (which may involve some strategies that reflect transmission patterns, and not just passive service provision), then from 2010 to 2030 it could be possible to reduce mortality from them by two-thirds; they fell by about a third per decade from 2000 to 2010.

This will, however, be a challenging target even in areas free from conflict. Reducing malaria mortality by a third during the past decade required substantial, complex efforts, and global commitment, and continuing to reduce it by about a third per decade could be increasingly difficult. Likewise, to continue successful control of HIV and tuberculosis, major political commitment will be needed, even if improved diagnostics and treatments can be widely deployed.<sup>13</sup>

For maternal mortality, the decrease noted in table 2 is 37% per decade, but this estimated decrease is steeper than other studies suggest.<sup>6,7</sup> If the current annual decrease is about 30% per decade, and this decrease can be maintained for 20 years, maternal mortality would be halved. Hence, the rate of decrease would have to steepen substantially by 2020 to achieve a two-thirds reduction by 2030. This ambitious target would mean a reduction to 77 per 100 000 livebirths, comparable with the targets of 70 and 94 suggested by others (panel 1).<sup>1,13</sup>

Finally, under-5 mortality accounts for the largest number of MDG-targeted deaths. Both MDG4 and our suggested target relate to under-5 mortality as a whole, since this is more reliably measurable than particular components of under-5 mortality. But, these particular components are of separate interest. The steepest decrease is the 67% fall within just one decade in mortality from the childhood cluster of vaccine-preventable diseases, illustrating the importance of national and international vaccination programmes. Although mortality rates from many other infective causes are also decreasing steeply (eg, 30–40% per decade), neonatal causes of death are not.<sup>5,13,38–40</sup> These

causes arising in the neonatal period are largely preventable or curable (and do not include congenital causes). But, serious adoption of the target of a two-thirds reduction in under-5 mortality from 2010 to 2030, if backed by appropriate resources, would accelerate progress. Achievement of this target would reduce under-5 mortality to just below 20 per 1000 livebirths, comparable with targets suggested by others (panel 1).<sup>9–13</sup>

For mortality at 5–69 years from the remaining communicable diseases (chiefly diarrhoea and pneumonia), the rate of decrease during 2000–10 was not as steep, so a smaller rate of reduction should perhaps be targeted. A reduction of a third over 20 years would represent moderate acceleration of the decrease during the previous decade. This reduction would require substantially improved health-care delivery to the subpopulations who are still at relatively high risk of death from curable infections.

If communicable disease mortality falls substantially, NCDs and injuries will increasingly predominate. Hence, without substantial extra efforts to reduce them, all-cause mortality is unlikely to decrease as rapidly in future decades as in the past decade. The reduction actually achieved in NCD mortality will be a key determinant of the reduction in overall mortality (particularly at 50–69 years, where NCDs cause more than 80% of all premature deaths), and UN/WHO initiatives are already addressing NCD control.<sup>28,41,42</sup>

The 2012 WHO 25×25 resolution targeted a 25% reduction from 2010–25 in NCD mortality at ages 30–69 years, specifying as 2025 subtargets changes in various NCD determinants.<sup>28</sup> The most important was 30% reduction in smoking, which in 2010 caused about a quarter of all cancer deaths in Europe and America (plus even more deaths from other diseases), and is already a major cause of death in China, India, and elsewhere in Asia. Fortunately, quitting works; smokers who stop before age 40 years (preferably well before 40) avoid more than 90% of the risk.<sup>22</sup> Hence, the 25×25 resolution supported the Framework Convention on Tobacco Control, whose many recommendations include major increases in specific excise taxes. Governments make about US\$300 billion per year directly or indirectly from tobacco. If increases in excise tax were to double real current cigarette prices, particularly affecting cheaper brands, this would reduce smoking by about a third, yet increase what governments make from tobacco to about US\$400 billion per year, in today's dollars.<sup>43</sup> The 25×25 resolution also targeted dangerous patterns of alcohol consumption (the predominant cause of premature death in Russia; appendix p 19); halting the present rise in obesity; and secondary prevention (effective, affordable treatment of those already identified as having disease, mainly with safe generics that do not require tertiary care).<sup>34</sup> The global decrease of 15% per decade in NCD mortality during 2000–10 should be somewhat exceeded during

the 2020s if there is good compliance with the 25×25 resolution over determinants of NCD mortality, with even greater effects thereafter.

Table 3 shows the importance, particularly at 5–49 years, of fatal injuries (mainly accidents, but also suicide and homicide). Alcohol is a major cause of accidents and other fatal injuries, and the main cause of premature death in some populations. With political commitment, practicable restrictions on alcohol pricing, advertising and convenience of purchase could in some populations substantially reduce these risks. Successful programmes to reduce mortality from suicide (within wider mental health programmes), homicide and, particularly, road accidents and the (more frequent) other accidents will be as complex to plan and carry through as those for disease control, and should include establishment of sustainable systems to register details of fatal injuries. More generally, if mortality targets and subtargets are adopted, appropriate epidemiological systems will be needed to monitor overall and cause-specific mortality in representative populations.<sup>16–18</sup>

## Panel 2: Research in context

### Previous studies

Millennium Development Goals targeted reductions from 1990 to 2015 in maternal, child, HIV, tuberculosis, and malaria mortality, and WHO has targeted 2010–25 reductions in premature (under 70 years of age) NCD mortality. To help quantify the 2010–30 UN Sustainable Development Goal for health (SDG3), we re-analysed data from the UN and WHO for recent global mortality trends to 2010.

### What this study adds

Maternal, child, HIV, tuberculosis, and malaria mortality are falling so fast that reduction by two-thirds during 20 years (2010–30) could feasibly be targeted. Other under-70 mortality is falling half as fast, suggesting a reduction by a third could feasibly be targeted. Achievement of both targets would reduce premature deaths by about 40%. Country-specific results suggest 40% reduction is feasible in many populations, but would be challenging to achieve by 2030.

### A quantitative target to accompany SDG3:

#### Avoid 40% of premature deaths, and improve health care at all ages

- Overarching target for mortality: avoid 40% of the premature deaths in each country (the deaths before age 70 years that would occur in that country's 2030 population at its 2010 death rates).
- Overarching target for health care at all ages: extend access to cost-effective, affordable treatment, including mental health and sexual, reproductive and perinatal services (with targets that are appropriately country-specific)
- Subtargets for global mortality from specific causes:
  - Avoid two-thirds of child and maternal deaths;
  - Avoid two-thirds of HIV, tuberculosis, and malaria deaths;
  - Avoid a third of premature deaths from other communicable diseases or injuries;
  - Avoid a third of the premature deaths from NCDs.

Achievement of these subtargets would halve under-50 mortality (avoiding 10 million of the 20 million deaths before age 50 years that would occur in the 2030 population at 2010 death rates), as well as reducing global premature deaths by about 40% (avoiding 17 million of the 41 million deaths before age 70 years that would occur in the 2030 population at 2010 death rates).

NCDs=non-communicable diseases.

Since national and international programmes to reduce mortality from the problems targeted by the MDGs are already working, continuation of these programmes is an important, cost-effective way to reduce overall mortality, as is substantial expansion of affordable health care, including sexual, reproductive, and perinatal health services. For communicable, maternal, and child mortality, a grand downward convergence between rates in different countries could

be largely achieved through health-system strengthening plus scale-up of proven, affordable health interventions and relevant research and development.<sup>13,21</sup>

Although the targeted reductions in particular causes improve only moderately on current rates of progress, they will not be achieved without sustained effort, targeted programmes, and additional finance for health care. If achieved, they avoid about 10 million of the 20 million deaths at 0–49 years (halving under-50

### Panel 3: Ethiopia<sup>4,6,39,44</sup>

Ethiopian health has progressed remarkably since 1990: the number of new HIV infections declined by 90% and under-5 mortality by 67%. The reasons (apart from ending armed conflict and its consequences) include health-care reforms with, as key factors, community empowerment and ownership through the flagship Health Extension Program (HEP); sustained political commitment at all levels; innovative solutions to problems like task-shifting; emphasis on building a resilient health system by leveraging domestic and international support; and ensuring equity of access to primary health care, providing key priority services and ensuring the worse off are not left behind.

In 1990, under-5 mortality 20.4%, mortality from tuberculosis, malaria, and HIV was high, and life expectancy was 45 years. Health policy decisions in 1993 articulated the changes needed to reverse the deteriorating health situation by treatment plus health promotion and disease prevention. 10 years later, the HEP was implemented at scale in all regions. HEP is supported by 38 000 rural and urban government-salaried Health Extension Workers, trained and equipped to support implementation of 16 “health promotive, disease preventive and basic curative health service packages” and brings services to the door-steps of each household, which makes it differ from conventional health-care delivery, where people go with their problems to health facilities.

HEP is coupled with accelerated expansion of health facilities (health posts, health centers, and hospitals), human resources (nurses, midwives, laboratory and pharmacy professionals, and doctors) and transformational change in the pharmaceutical funding and supply system. Health, and health reform, has been greatly helped by social changes involving peace, avoidance of famines, economic growth, education, safe drinking water, and clean energy. Health indicators have improved profoundly since 1990: under-5 mortality fell to 6.8% (surpassing MDG4 3 years early); tuberculosis and malaria mortality halved, and life expectancy rose to 65 years. The mortality decreases were particularly steep during the past decade (2000–10; table 1, figure 3). If recent past achievements predict future attainments, during 2010–30 Ethiopia will roughly halve the remaining risks of premature death, especially with its plans for coordinated and sustained mitigation of mortality and morbidity from injuries and NCDs.

### Panel 4: Mexico<sup>46-54</sup>

From 1970 to 2010, Mexican mortality fell six-fold at ages 0–4 years (from 12% to 2%), three-fold at ages 5–49 years (from 17% to 6%), and two-fold at ages 50–69 years (from 33% to 17%). These substantial decreases, which are similar to those in several other countries, were about as steep before as after the 1990s health-care reforms (figure 3).

Although other factors also had an important role, the major Mexican health-system strengthening initiatives and special programmes of the past three decades must have reduced mortality. In the 1990s, Mexico expanded the health-care infrastructure in poorer states and increased regular access of the poor to 12 essential interventions (Extension of Coverage Program), and in 2004 Congress extended social protection in health to the non-salaried. The supply of safe water and sanitation improved, and community-based interventions targeted malnutrition and common childhood infections (eg, National Program to Control Diarrheal Diseases [1984], Universal Immunization Program [1991] and Fair Start in Life [2002]). Vaccines were given during national health weeks, along with promotion of oral rehydration. In 1997, a conditional cash transfer programme began, enhancing the capabilities of families in extreme poverty.

Will premature mortality continue to decline steeply? As shown in table 1, under-5 mortality is still decreasing by a third per decade and premature mortality is now mainly at ages 50–69 years, where NCDs predominate and the World Health Assembly 25 × 25 resolution on NCDs applies (panel 1). Secondary prevention, a 30% reduction in smoking and a halt to the rise in adiposity are needed. In urban Mexico, 20% smoke, a difficult-to-quantify proportion drink hazardously, and by middle-age 32% are obese, 16% are diabetic, and half have high blood pressure or cholesterol, mostly undiagnosed or under-treated. The new National Strategy for Control of Obesity and Diabetes [2013] includes (1) health promotion, NCD prevention and monitoring; (2) early risk factor identification, including diabetes; and (3) fiscal policies for health, including new taxes (eg, US\$0.07 per L on sugary drinks and 8% on high-calorie junk food). Likewise, Mexican taxes are only 62% of cigarette prices; raising this to 75% could reduce numbers of people smoking by a few million yet generate tens of billions of pesos in annual revenue. Despite all these major issues, however, Mexican death rates have never been lower, and are still falling steeply.

mortality), and about 17 million (40%) of the 41 million deaths at 0–69 years (table 3). They do not, however, greatly change global population growth in old age, which is driven more by intergenerational demographic changes than by the moderate proportional changes in the probability of reaching old age seen in figure 1A. Likewise, moderate proportional increases in the probability of surviving childhood would have little direct effect on the dynamics of population growth, and may well help limit reproduction rates.<sup>23</sup>

Reducing premature death is a flexible target that can be pursued in different ways in different countries, according to their mortality patterns and resources. In low-income countries, the number of premature deaths in 2030 at 2010 death rates will be three times as great before age 50 years (6 million) as at 50–69 years (2 million), whereas in upper-middle-income plus high-income countries the opposite is true (4 million before age 50 years vs 11 million at 50–69 years; appendix pp 14–18).

Countries with high under-50 mortality (such as Ethiopia, panel 3) can prioritise reducing mortality from communicable, perinatal, and maternal causes, and mortality from injuries (mainly accidents rather than suicide or homicide). Investing in cost-effective health care to achieve this yields economic returns and substantially improves life expectancy.<sup>13,45</sup> (The Disease Control Priorities Project keeps a wide range of health-related interventions under review to determine their feasibility and cost-effectiveness.<sup>21</sup>)

Countries with low under-50 mortality (such as Mexico, panel 4) might prioritise controlling mortality from NCDs, which predominate in the 50–69 year age group; NCD control also reduces disability. Where social inequalities within countries strongly affect mortality, emphasis on overall mortality and affordable access should promote equity by targeting those at highest risk.<sup>55</sup> China's recently introduced nationwide health insurance system now covers 20% of the world's population and should improve equity.

Returning to the 2016–30 SDG for health, whatever is proposed should balance aspiration with technical feasibility,<sup>15</sup> and should engender better vital statistics.<sup>16–18</sup> The current proposal for SDG3 (panel 1) could be accompanied by something that is in part quantitative, feasible and measurable, such as “Avoid 40% of the premature deaths in each country, and improve health care at all ages”, especially if this is accompanied by appropriate subtargets (panel 2).

Indeed, in some populations the subtarget of “Halve under-50 mortality” might be given much greater emphasis than the main target,<sup>56</sup> whereas in others “Avoid a third of premature deaths from NCDs” might do so. In all cases, however, reduction in fatal injuries (as well as in medical causes of death) would also be important. If the total number of premature deaths is to be reduced, current national age-specific, cause-specific mortality patterns should be major determinants of national priorities.

Even in upper-income, low-mortality countries, avoiding about 40% of the deaths before age 70 years would be important, and should be achievable. In countries with higher risks of death in childhood and early adult life, avoiding 40% of the premature deaths yields larger absolute gains, and should be more easily achievable, at least in areas free of political disruption and war.

#### Contributors

RP had the initial idea, with input from TG, DTJ, PJ, and OFN. PJ, CM, OFN, and RP sourced or led the analyses of mortality trends by RJH, HP, and WS. OFN and RP drafted the text; KA, OG-D, MK, JS, ATM, and GY drafted panels; and all authors subsequently read, revised, and approved the report. KA, TG, CDM, and ATW contributed personally, not for the WHO or their Governments. OFN and RP had final responsibility for submitting for publication.

#### Acknowledgments

NORAD provides funding for the Priorities in Global Health project at the University of Bergen, the Li Ka Shing Foundation supports the Centre for Global Health Research at St Michael's Hospital, University of Toronto, the Bill and Melinda Gates Foundation supports DTJ through the Disease Control Priorities Project at the University of Washington, and the British Heart Foundation, Cancer Research UK, and Medical Research Council provide core funding for the University of Oxford NDPH CTSU.

#### References

- 1 Open Working Group. Outcome Document—Open Working Group on Sustainable Development Goals. 2014 <http://sustainabledevelopment.un.org/focussdgs.html> (accessed July 25, 2014).
- 2 UN. Resolution adopted by the General Assembly, Oct 19, 2010. New York: United Nations, 2010.
- 3 United Nations Sustainable Development Knowledge Platform. Sustainable development goals. 2014 <http://sustainabledevelopment.un.org/?menu=1300> (accessed July 10, 2014).
- 4 UNICEF. Monitoring the situation of children and women. 2014. <http://data.unicef.org/about> (accessed July 15, 2014).
- 5 Wang H, Liddell CA, Coates MM, et al. Global, regional, and national levels of neonatal, infant, and under-5 mortality during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2014; published online May 2. [http://dx.doi.org/10.1016/S0140-6736\(14\)60497-9](http://dx.doi.org/10.1016/S0140-6736(14)60497-9).
- 6 WHO, UNICEF, UNFPA, The World Bank, United Nations Population Division. Trends in maternal mortality: 1990 to 2013. Estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division. Geneva: World Health Organization, 2014.
- 7 Kassebaum NJ, Bertozzi-Villa A, Coggeshall MS, et al. Global, regional, and national levels and causes of maternal mortality during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2014; published online May 2. [http://dx.doi.org/10.1016/S0140-6736\(14\)60696-6](http://dx.doi.org/10.1016/S0140-6736(14)60696-6).
- 8 Liu L, Johnson HL, Cousens S, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet* 2012; **379**: 2151–61.
- 9 United Nations. Report of the secretary-general's high-level panel of eminent persons on the post-2015 development agenda. 2014. <http://www.un.org/sg/management/beyond2015.shtml> (accessed July 10, 2014).
- 10 United Nations. Sustainable Development Solutions Network. An action agenda for sustainable development. 2014. <http://unsdsn.org/wp-content/uploads/2013/06/140505-An-Action-Agenda-for-Sustainable-Development.pdf> (accessed July 10, 2014).
- 11 United Nations Global Compact. Post-2015 agenda and related Sustainable Development Goals issue focus: the role of business in improving health. [http://www.unglobalcompact.org/docs/issues\\_doc/development/Post2015/Health\\_Issue\\_Brief.pdf](http://www.unglobalcompact.org/docs/issues_doc/development/Post2015/Health_Issue_Brief.pdf) (accessed July 10, 2014).
- 12 UNICEF. A post-2015 world fit for children. 2013. [http://www.unicef.org/post2015/files/Post\\_2015\\_Key\\_Ask\\_V01.pdf](http://www.unicef.org/post2015/files/Post_2015_Key_Ask_V01.pdf) (accessed July 10, 2014).

- 13 Jamison DT, Summers LH, Alleyne G, et al. Global health 2035: a world converging within a generation. *Lancet* 2013; **82**: 1898–955.
- 14 Task team for the global thematic consultation on health in the post-2015 development agenda (2013): Health in the post-2015 agenda. <http://www.worldwewant2015.org/file/337378/download/366802> (accessed Sept 16, 2014).
- 15 Yamey G, Shretta R, Binka FN. The 2030 sustainable development goal for health must balance bold aspiration with technical feasibility. *BMJ* 2014; **349**: g5295.
- 16 Jha P. Reliable direct measurement of causes of death in low- and middle-income countries. *BMC Med* 2014; **12**: 19.
- 17 Lopez AD, Thomason J. Civil registration and vital statistics—everybody's business but nobody's business. *Lancet* 2013; **381**: 1275–76.
- 18 Phillips DE, Lozano R, Naghavi M, et al. A composite metric for assessing data on mortality and causes of death: the vital statistics performance index. *Pop Health Metrics* 2014; **12**: 14.
- 19 Murray CJL, Ezzati M, Flaxman AD, et al. GBD 2010: design, definitions, and metrics. *Lancet* 2012; **380**: 2063–66.
- 20 Stenberg K, Axelson H, Sheehan P, et al. Advancing social and economic development by investing in women's and children's health: a new Global Investment Framework. *Lancet* 2014; **383**: 1333–54.
- 21 Jamison DT, Breman JG, Measham AR, et al. Disease control priorities in developing countries. 2nd edn. New York: Oxford University Press and The World Bank, 2006.
- 22 Jha P, Peto R. Global effects of smoking, of quitting, and of taxing tobacco. *N Eng J Med* 2014; **370**: 60–68.
- 23 World Bank. Investing in health. Washington DC: World Bank, 1993.
- 24 Murray CJL, Vos T, Lozano R, 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**: 2197–23.
- 25 Victora CG, Buffer P, Ebrahim S, et al. Health in the post-2015 development agenda. A position paper by the International Epidemiological Association. 2012. <http://www.worldwewant2015.org/node/292903> (accessed July 4, 2014).
- 26 Thornicroft G, Patel V. Including mental health among the new sustainable development goals - the case is compelling. *BMJ* 2014; **349**: g5189.
- 27 Murray CJL, Ortblad KF, Guinovart C, et al. Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2014; published online July 21. [http://dx.doi.org/10.1016/S0140-6736\(14\)60844-8](http://dx.doi.org/10.1016/S0140-6736(14)60844-8).
- 28 WHO. Sixty-fifth world health assembly: resolution A65/54, 25 May, 2012. [http://apps.who.int/gb/ebwha/pdf\\_files/WHA65/A65\\_54-en.pdf](http://apps.who.int/gb/ebwha/pdf_files/WHA65/A65_54-en.pdf) (accessed June 23, 2014).
- 29 UNPD. World population prospects: the 2012 revision. Washington: United Nations, 2012.
- 30 WHO. WHO Global Health Observatory. 2014. [http://www.who.int/healthinfo/global\\_burden\\_disease/estimates/en/index1.html](http://www.who.int/healthinfo/global_burden_disease/estimates/en/index1.html) (accessed June 29, 2014).
- 31 World Bank Group. The World Bank list of economies, July 2012. 2012 <http://www.worldbank.org/> (accessed June 15, 2014).
- 32 Zaridze D, Lewington S, Boroda A, et al. Alcohol and mortality in Russia: prospective observational study of 151 000 adults. *Lancet* 2014; **383**: 9927.
- 33 Doll R. Foreword. In: Peto R, Lopez AD, Boreham J, Thun M, eds. Mortality from smoking in developed countries 1950–2000. Oxford: Oxford University Press, 1994.
- 34 Salomon JA, Wang HD, Freman MK, et al. Healthy life expectancy for 187 countries, 1990–2010: a systematic analysis for the Global Burden Disease Study 2010. *Lancet* 2012; **380**: 2144–62.
- 35 Sepúlveda J, Murray CJL. The state of global health in 2014. *Science* 2014; **345**: 1275–78.
- 36 Lozano R, Naghavi M, Foreman K, 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**: 2095–128.
- 37 Requejo J, Bryce J, Victora C. Countdown to 2015. Maternal, newborn & child survival. Fulfilling the health agenda for women and children. The 2014 Report. New York and Geneva: UNICEF, World Health Organization, 2014.
- 38 Lawn JE, Couzens S, Zupan J. 4 million neonatal deaths: when? Where? Why? *Lancet* 2005; **365**: 891–900.
- 39 UN Inter-agency Group for Child Mortality Estimation. Levels and trends in child mortality. Report 2013. Geneva, New York: UNICEF, World Health Organization, The World Bank, United Nations, 2013.
- 40 Bhutta ZA, Das JK, Bahl R, et al. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? *Lancet* 2014; **384**: 347–70.
- 41 Di Cesare M, Khang Y-H, Asaria P, et al. Inequalities in non-communicable diseases and effective responses. *Lancet* 2013; **381**: 585–97.
- 42 WHO. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2011.
- 43 Yusuf S, Rangarajan R, Teo K, Islam S, Li W, et al. Cardiovascular risk and events in 17 low- middle and high-income countries. *New Engl J Med* 2014; **371**: 818–27.
- 44 WHO. World Health Organisation, Global Health Estimates 2013. 2014. [http://www.who.int/healthinfo/global\\_burden\\_disease/en/](http://www.who.int/healthinfo/global_burden_disease/en/) (accessed May 29, 2014).
- 45 Boyle CF, Levin C, Hafei A, et al. Achieving a “grand convergence” in global health: modeling the technical inputs, costs, and impacts from 2016 to 2030. <http://www.globalhealth2035.org/working-papers> (accessed 14 September 2014).
- 46 Frenk J, Gómez-Dantés O, Knaul FM. The health systems agenda: prospects for the diagonal approach. In: Brown GW, Yamey G, Wamala S, eds. The handbook of global health policy. West Sussex, UK: John Wiley & Sons, 2014: 425–39.
- 47 Sepúlveda J, Bustreo F, Tapia R, et al. Improvement of child survival in Mexico: the diagonal approach. *Lancet* 2006; **368**: 2017–27.
- 48 Knaul FM, Gonzalez-Pier E, Gomez-Dantes O, et al. The quest for universal health coverage: achieving social protection for all in Mexico. *Lancet* 2012; **380**: 1259–79.
- 49 WHO, UNICEF. Progress on sanitation and drinking water. 2010 Update. Geneva: World Health Organization, 2010.
- 50 Acosta-Cázares B, Escobedo-de la Peña J. High burden of cardiovascular disease risk factors in Mexico: an epidemic of ischemic heart disease that may be on its way? *Am Heart J* 2010; **160**: 230–36.
- 51 Roth GA, Fihn SD, Mokdad AH, Aekplakorn W, Hasegawa T, Lim SS. High total serum cholesterol, medication coverage and therapeutic control: an analysis of national health examination survey data from eight countries. *Bull World Health Organ* 2011; **89**: 92–101.
- 52 Barquera S, Campos-Nonato I, Hernández-Barrera L, et al. Hypertension in Mexican adults: results from the National Health and Nutrition Survey 2006. *Salud Pública de México* 2010; **52**: 63–71.
- 53 Astudillo O. Country in Focus: Mexico's growing obesity problem. *Lancet Diabetes Endocrinol* 2014; **2**: 15–16.
- 54 Waters H, Sáenz de Miera B, Ross H, Shigematsu LMR. The economics of tobacco and tobacco taxation in Mexico. Paris: International Union Against Tuberculosis and Lung Disease, 2010.
- 55 Vaupel J, Zhang Z, van Raalte A. Life expectancy and disparity: an international comparison of life table data. *BMJ Open* 2011; **1**: e000128.
- 56 Peto R, Lopez AD, Norheim OF. Halving premature death. *Science* 2014; **345**: 1272.