Documenting the Global Burden of Cardiovascular Disease  
A Major Achievement but Still a Work in Progress  
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The publication of the 1990 Global Burden of Disease (GBD) was a seminal moment for international health. In a world characterized by what has been termed a “scandal of ignorance,” where most peoples’ existence was never recorded, the authors undertook the heroic task of estimating not only how many people were dying and from what conditions but also how many were living with disability. By combining these measures to create the disability-adjusted life year, they changed the global health discourse forever. The task was enormous. They had to include all countries, including many that had attracted virtually no attention from health researchers and that lacked vital registration systems. They scoured the world for data, extracting information from dusty archives, and analyzed surveys that had been forgotten. 

These efforts, in turn, have stimulated a massive increase in data collection, with expansions in vital registration systems, sentinel surveillance sites, and methodologic refinements of instruments such as verbal autopsy. They also developed ambitious methodologic and empiric approaches to understand associations between mortality and the much less well researched disability and to measure the contribution of different disease states to both.

These processes led to the creation of the Global Burden of Disease 2010 (GBD 2010) report. These efforts, in turn, have stimulated a massive increase in data collection, with expansions in vital registration systems, sentinel surveillance sites, and methodologic refinements of instruments such as verbal autopsy. The authors created complex (although, for some, virtually incomprehensible) models that established relationships in countries with data for variables such as national income and patterns of disease and then extrapolated to countries and regions or for conditions where data were unavailable to fill the many gaps. They also developed ambitious methodologic and empiric approaches to understand associations between mortality and the much less well researched disability and to measure the contribution of different disease states to both.

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First, these articles confirm the success in reducing mortality from cardiovascular disease (CVD) in most rich countries. These are remarkable public health achievements. However, progress in other parts of the world has been slow or nonexistent. In Eastern Europe and parts of Asia, the situation worsened (although it may be improving at long last in Russia). Clearly, it is important to understand factors associated with success so that they can be emulated elsewhere. Research such as that using the IMPACT model has been crucial, distinguishing the impact of different preventive and treatment measures. These studies show that ≈90% of the decline could be explained, and, of this, approximately half can be attributed to improved treatments, with the other half to reductions in risk factors such as smoking, cholesterol, and blood pressure levels, although this has been counterbalanced to some extent by increasing obesity and diabetes mellitus. Many of the gains can be attributed to the increased use of simple medicines for secondary prevention, better management of acute coronary syndromes, and improved management of heart failure and hypertension.

The message for low- and middle-income countries (LMIC) is clear. Enormous progress can be made by implementing a comprehensive package of simple, low-cost policies. Some countries, such as New Zealand, have set a target to eliminate smoking by 2020. This should now be the gold standard. Anything less displays a profound lack of ambition. Action is also needed on diet. Many LMICs are being flooded with energy-dense food and drink, marketed aggressively by multinational corporations, or with unhealthy products made in large quantities as a consequence of market-distorting subsidies for farmers in wealthy countries, such as high fructose corn syrup. Public health policies (on tobacco, diet, and activity) based on sound evidence are required and must be accompanied by improved access to inexpensive but effective medications. This is not just a matter of money. Even in many of the wealthiest countries, control of hypertension or use of simple, proven, and inexpensive medications for secondary prevention is suboptimal. Where success has been achieved it has involved the development of culturally and contextually appropriate approaches to healthcare delivery, reaching out to those who are most disadvantaged to minimize disparities.

Second, most figures produced by the GBD are from models populated primarily by data from rich countries, because vital registration systems are mostly confined to high and upper middle-income countries. These have also been the setting for the most research in CVD. Consequently, it is largely a matter of conjecture as to whether such estimates are sufficiently reflective of middle- and low-income countries, from which there is relatively modest information.

Countries in a region with sufficient infrastructure in place to collect data may also have better functioning health systems than their neighbor countries that are unable to provide data. This is a major problem when assessing changes in CVD. Health systems to document disease burden and to prevent and treat common noncommunicable diseases (NCDs) should be
essential components of the international development agenda. The Millennium Development Goals, which have driven donor efforts since 2000, did not include NCDs, in large part because of a lack of relevant data on the NCD burden. This contrasts with maternal and child health, which were included because they were monitored periodically in the Demographic and Health Surveys in those countries lacking vital registration.

The situation is, however, changing. Sentinel surveillance sites, such as those in the International Network for the Demographic Evaluation of Populations and their Health in Developing Countries (INDEPTH) network, have shown the alarming growth in cardiovascular risk factors in some low-income settings. Research using the IMPACT model in some middle-income countries shows that, although improved prevention and treatment are making a difference, they are failing to keep up with the rapidly worsening risk factors.

Finally, recent data from the first round of follow-up of the Prospective Urban and Rural Epidemiology Study, tracking 155,000 individuals in 628 communities in 17 countries at all economic levels, has documented higher mortality and CVD despite lower risk factor burden in poor countries. This was paralleled by lower rates of use of secondary prevention medications and hypertension control in poorer countries and suggests that these countries have less well-functioning healthcare systems compared with richer countries.

It is, however, essential to recognize that models of care used in high-income countries cannot automatically be transferred to LMICs, where the context and especially access to resources are very different. For example, most high-income countries spend ≈10% (ranging from 8% to as high as 18% in the United States) of their GDP on health, whereas LMIC generally spend only ≈2% to 5% of their (much lower) GDPs on health care. Instead, effective solutions at much lower costs are needed for LMICs. For example, in countries with few health professionals, most tasks can be shifted to midlevel nonphysician health workers (NPHWs) rather than depending on the handful of often grossly overloaded physicians and nurses. CVD control tasks that can be shifted include screening for hypertension, ongoing management of individuals with stable vascular disease with simple drugs and lifestyle advice, identifying individuals with prevalent CVD and diabetes mellitus, and communicating that these diseases require lifelong medications and lifestyle changes, even in asymptomatic individuals.

Yet, whereas NPHWs can make as valid decisions as physicians regarding prevention and treatment pathways for CVD, in many countries there are legislative barriers to the use of NPHWs (only physicians may be allowed to prescribe drugs in many countries, or patients expect that decisions on treatments made by physicians are superior). These barriers can be overcome through changes in legislation that allow NPHWs the ability to prescribe a small range of simple, effective, and safe drugs; to educate patients to accept NPHWs; and to combine these with strategies to improve adherence. Furthermore, NPHWs can visit patients at their homes (as is done for immunizations and tuberculosis and malaria control in some countries), thereby improving access of patients to healthcare and simultaneously reducing their out-of-pocket costs related to traveling long distances to see physicians. This also avoids or minimizes their expenditure on physician fees and loss of time (and income) from missing work. A further challenge, in some LMICs, is the presence of different health belief systems. Changes require visionary leadership and, although some LMICs have achieved much in implementing evidence-based policies on healthcare delivery, supported by effective institutions and governance, most have not.

A parallel goal of the GBD project has been to quantify the contributions of specific health behaviors and risk factors to CVD (and other common conditions) as described previously. However, because of an overreliance on the epidemiologic data, some of the estimates of the degree of attribution of certain risk factors are questionable. Although estimates of the impact of tobacco use on CVD are relatively robust, the impact of cholesterol on CVD is likely a major underestimate, because the evidence from randomized clinical trials indicating clear reductions in stroke is ignored (whereas the lack of association of cholesterol with stroke seen in some epidemiologic studies is given undue weight in the GBD). Conversely, the importance of blood pressure as a modifiable cause of CVD may be overestimated, because there is as yet no evidence that lowering blood pressure, per se, in those with a systolic blood pressure <140 mm Hg reduces CVD. The large impact attributed to salt intake is a triple extrapolation, with assumptions that the association of sodium intake to blood pressure is linear (contradicted by a large recent study), that the association between sodium intake and CVD is continuous (which has been challenged), and that sodium reduction will lower CVD, which has never been demonstrated in randomized clinical trials. Although there is ecological evidence from countries where sodium consumption was historically very high (>8 g of sodium per day) that reductions in salt consumption reduce stroke and perhaps other CVD, evidence that further reducing sodium from population levels where sodium consumption is already <5 g/d will lead to a reduction in CVD is not available. Therefore, the potential impact of sodium reduction on CVD in the GBD study is likely to be substantially overestimated (perhaps by as much as 5 to 10 fold). Similarly, the claims that increasing fish or fish oils in the diet will reduce CVD have been refuted by large recent trials, and the epidemiologic data that fish consumption will reduce CVD are not robust. Therefore, quantification of the impact of some of the health behaviors and risk factors on the global burden of CVD needs to be revisited as more or better data accrue. Of course, none of these concerns diminish the enormous contributions of the GBD project toward setting an expanded global agenda that includes CVD and other NCDs.

Undoubtedly, there will be future cycles of the GBD. What can be done to improve the reliability of future estimates? First, we need very large studies (and by necessity ultrasound ones) conducted in as many LMICs as possible, using innovative designs (eg, representative household surveys and obtaining information from key respondents) that can document morbidity and mortality and relate them to simple risk factors and health behaviors. By comparing behaviors of individuals who had experienced an event with those who did not, the impact of the risk factors on specific conditions can be studied efficiently in representative populations in different LMICs. Information from some of the large ongoing prospective epidemiologic studies, such as the Kadoorie study in China,
which includes multiple provinces\textsuperscript{18}; the Prospective Urban and Rural Epidemiology Study, now in 21 countries\textsuperscript{30}; and the INDEPTH network in 18 countries\textsuperscript{36} will also help provide new information that will make future estimates of the disease burden and their causes more reliable.

Ultimately, the generation of reliable data on disease burden should be one of the cornerstones of developing evidence-based global, region-, and country-specific public health strategies for CVD prevention. Such information is essential to inform the development of appropriate healthcare systems that are effective and responsive to the needs of subnational administrative units within each country and across various countries in each region. It is no coincidence that countries with good documentation of their mortality and morbidity are also the ones that develop policies and care systems that improve health in their countries. Such information is also critical for making a case to governments and international donors for appropriate investments in the control of CVD and other NCDs. Such new information will make future GBD estimates less reliant on complex modeling, more transparent, and likely more robust. The dual strategy of simultaneously obtaining more robust information will make future GBD estimates less reliant on investments in the control of CVD and other NCDs. Such new case to governments and international donors for appropriate


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