A RACE AGAINST TIME
The challenge of cardiovascular disease in developing economies

2nd Edition
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Preface
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Foreword
K. Srinath Reddy

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DEFINITIONS USED IN THIS REPORT

HIGH-INCOME COUNTRIES
For the 2015 fiscal year, The World Bank divides the economies of countries according to 2013 GNI (gross national income) per capita, per annum, calculated using the World Bank Atlas method. A country is considered high income if its GNI per capita is more than $12,746. According to the World Bank, there were 75 high-income countries in 2015 fiscal year.

MIDDLE-INCOME COUNTRIES
Middle-income countries are further classified into lower middle-income (per-capita GNI, $1045-$4125) and upper middle-income groups (per-capita GNI, $4125-$12,746). In 2015 fiscal year, there were 50 lower middle-income and 55 upper middle-income countries according to the World Bank.

LOW-INCOME COUNTRIES
A country is considered as low-income if the per-capita GNI is $1,045 or less. There were 34 low-income countries in 2015 fiscal year.

DEVELOPING COUNTRIES OR ECONOMIES
Low-income and middle-income countries are sometimes referred to as developing countries or economies.

THE NEED TO ALIGN THE ACADEMIC GLOBAL PUBLIC HEALTH CURRICULUM WITH GLOBAL PUBLIC HEALTH REALITIES
Henry Greenberg, MD, Susan U. Raymond PHD, Stephen R. Leeder MD, PHD, FRACP

We are delighted to offer this preface to the second edition of *A race against time*. It is invigorating to see that a new generation of investigators and authors has picked up the leadership of this project. We are confident that this edition will further advance the field of global chronic disease public health and further influence the global priorities of the assistance community. We are particularly appreciative of the efforts of Dr Harikrishnan, Dr Prabhakaran, Dr Mark Huffman and Dr Jeemon.

There is one area in which we would like to offer an argument for greater attention. The academic public health community needs to embrace chronic disease with far greater vigour going forward than it has done in the past. We posit that this engagement will require far more complex changes in curriculum than adding new courses and new datasets for new diseases. As the faculty of Columbia’s Mailman School of Public Health (1) and we (2) have argued, public health must migrate from the paradigm of medical care to population intervention. It must go upstream, and far upstream, to confront the societal drivers of cardiovascular disease (CVD) and cardiac disease risk factor behaviour. Further, it must proactively seek a seat at the “big table” of national policy regarding drivers of population health. Health care delivery, if it is to be effective, will be expensive everywhere and the health budget cannot be viewed as simply a ministerial line item in a national budget. We would argue that every ministry needs to have a health-related portfolio as part of its overall mandate.

Schools of public health in the United States tend to be “soft money” schools, with most faculty funded primarily by external grants. The current grant climate for global health focuses on the triad of HIV/AIDS, tuberculosis and malaria, with HIV/AIDS holding an overriding dominance. According to data compiled by the Kaiser Family Fund, HIV/AIDS attracts more than 60% of all US global health funds and the triad receives upwards of 75% (3). Chronic disease gets little more than a rounding figure buried in the approximately 1% categorised as “other”. Faculty teach what they know, and their current roles are endorsed by the support of and recognition by the leading funding organisations. And to be sure, these three diseases are not unimportant problems, and, until recently, HIV/AIDS was the critical public health...
HIV has become a chronic disease, and it is being tackled successfully as such. According to UNAIDS (4), and supported by data used by others, the incidence of HIV/AIDS is falling, survival rates are increasing, mother-to-child transmission is beginning to plummet, and the proportion of eligible patients being treated with antiretroviral therapy is nearly 50% in sub-Saharan Africa. And crucially, more than 50% of the funding for HIV/AIDS in developing countries is supplied by these countries themselves. The trajectories of all these data curves point to an ultimate “win”. The disease will not disappear tomorrow, there remains much to do, unforeseen barriers will no doubt emerge, and funding will always be tenuous and will rarely meet need. In addition, there are regions or countries with significant under-reporting or serious pockets of unrecognised disease. Treatment and management will arrive late, although much of this may not require external assistance for control. But the overwhelming success of the recent past will prevail and this optimism is perpetuated by the data from the HIV/AIDS research communities.

At an accelerating pace since first brought to attention of the public health world by Omran in 1971 (5), chronic diseases, particularly the cardiovascular constellation of conditions, which includes diabetes mellitus and cancers, have assumed an ascending and now dominant role in emerging economies. The Global Burden of Disease series, first in the 1990s (6) and recently in 2012 (7), and our own work in the first edition of A race against time (8) has documented this. It is now universally recognised that these conditions are the planet’s dominant health issues. For example, in India, with a median age of a youthful 26 years, chronic disease accounts 53% of mortality and the CVD risk factor profile points to a rapidly increasing proportion (9). Even more dramatic is a recent report from Tanzania showing that the age-adjusted stroke rate in Dar es Salaam exceeds that of New York City’s Harlem (10).

The disconnect between the almost explosive emergence of chronic diseases in the developing world and the lack of funding to address them is both striking and disheartening. However, there are signs that the barriers may be breached. The UN General Assembly highlighted chronic diseases in 2011, only the second time they were an issue of the age.

One argument might be to use the workforce trained in HIV/AIDS, as they have the experience is dealing with chronic disease. We would argue that the skillsets required for HIV/AIDS are inadequate to the task and will be unlikely to transfer effectively to the new demands of CVD or cancer. HIV/AIDS management is chronic disease management but is linear and narrow – getting the systems right for medication delivery. This success, to be sure, is a major contribution to all of global health. HIV/AIDS has learned to focus educational expertise on schools and select populations in the community, to align drug production, pricing, and delivery, to begin to reduce the stigma of the diagnosis, and to create a bottom-up series of activities that help sustain robust funding. However, the scope of CVD risk factor modification is vastly more complicated than this and requires a far broader array of skills.

CVD risk reduction will require intervention on all sorts of levels. Public health professionals will need to engage tax policy, trade policy, agricultural subsidies, urban planning, socioeconomic patterns of behaviour, the impact of commercial advertising, as well as the complex issues that surround health care financing, patterns of health care delivery and determination of priorities.

This will require new patterns of public health education with a curriculum that may well extend well beyond the confines of a school of public health. Not only the medical school, but also the schools of business, law, international affairs, architecture and urban planning, and departments of communications, sociology, anthropology and economics will be able to contribute to this curriculum and will likely even be necessary for this education to attain a robustness needed to produce an effective 21st-century public health professional. Mid-career, retooled HIV/AIDS workers may not find a warm welcome or firm embrace.

How should schools of public health proceed? Few, if any, can fund new departments and create new concentrations of study. Students still look forward to global health careers in HIV/AID and other, even more traditional infectious diseases. There are no quick, easy answers, but there are steps to take. We offer several suggestions.

First, the schools individually and collectively through the organisations that bind them need to approach the dominant funding organisations and make the case for the future.

Second, the various national and international cardiac, cancer, and pulmonary organisations and their alliances can be approached and mobilised to support this effort, and these organisations themselves may be able to initiate training grants and pilot studies.

Third, curriculum initiatives that highlight the coming epidemic of chronic dis-
ease can begin to tilt student interest toward these problems. These initiatives can encompass a broadening of the core curriculum to emphasise chronic disease as well as engaging faculty from within the university to offer new elective courses that are tied to the new core curriculum and supported at the highest levels of the schools.

Without abandoning the commitment to the problems of the present, the schools can begin to assume a leadership role in creating a professional public health workforce committed to the future.

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REFERENCES


By a curious coincidence, just as I set out to write this foreword to the second edition of *A race against time*, another request for a foreword landed with me, accompanied by a book written by senior Indian journalist Dinesh Sharma. In the preface to that book, *Know Your Heart*, Sharma writes of a media workshop he attended 10 years ago, in which my colleagues and I engaged Indian journalists on issues related to the rising threat of CVD in India. He candidly states that he later discarded the several WHO documents and journal articles he received in his kit but preserved one book – the first edition of *A race against time*. That book stimulated him to delve more deeply into the course and causes of the calamitous rise of cardiovascular diseases in India. Sharma’s book, which provides a serious sociopolitical analysis of the problem, is a fitting tribute to his distant mentors who published *A race against time* in 2004.

Indeed, the first edition of *A race against time* had that kind of an impact on many individuals and institutions – health professionals, policymakers, health advocates, international organisations, foundations and, of course, the media and lay readership. It not only laid out the stark statistics of the mounting numbers of death due to heart disease in different regions globally, but also made a compelling case for urgent action by highlighting the disastrous economic costs of continued neglect. There is no doubt that the book proudly influenced global health debates and led to the World Bank and the United Nations revising their previous positions on the global threat of non-communicable diseases (NCDs).

The second edition of *A race against time* is also well timed. While the Political Resolution of the UN in September 2011 recognises the threat posed by NCDs to global development and acknowledges the bi-directional links between NCDs and poverty, national and global responses have been feeble so far. The multisectoral policy alignment needed to protect and promote cardiovascular health as well as the integrated health system responses required to provide a wide range of services across the life course are not yet a feature of national planning or global funding. The replacement of the Millenium Development Goals in 2015 by the Sustainable Development Goals (SDGs) offers an opportunity to firmly position CVD and other NCDs in the evolving global development agenda. The updated information and fresh analyses provided in this second edition will help to inform the diverse stakeholders engaged in the development of the SDGs and make a strong case for the clear positioning of NCD prevention and control in the health SDG.

This new edition not only sounds a fresh alarm about the advancing tsunami of global CVD, but also provide a road-map for how to counter and contain that threat. It presents new data on global trends in CVD, while using five countries as exemplars of different regions. Building on evidence from several countries, it provides the course coordinates for concerted actions which are needed both for population health and individual protection. While warning against the costs of inaction, it provides a template of cost-effective interventions which can save millions of lives and billions of dollars. If we have to win the race against time, this is the GPS which we must use to speedily steer our collective response to the global CVD epidemic.

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INTRODUCTION

The first edition of this report (1) was derived from a project conducted at Columbia University during 2003, which examined the economic and social consequences of CVD in developing economies. The project followed on from the work of the Commission on Macroeconomics and Health (CMH), chaired by Professor Jeffrey Sachs. The principal investigators on the project were Stephen Leeder, Susan Raymond and Henry Greenberg. Hui Liu was a research associate, and Kathy Esson served as a research associate and as contributing editor. The report was published in 2004.

This second edition is an update and incorporates new data published since 2004, and new developments in CVD prevention in both populations conducted (8). There is widespread agreement that risk factors are appropriate foci of preventive efforts in relation to CVD in both developed and developing countries, because to the degree that an individual’s risk factor profile is reduced, his or her susceptibility of developing end organ disease also decreases. The ability to treat these risk factors in individuals does not exclude the importance of counteracting adverse societal forces in society that lead to the CVD epidemic.

These adverse social factors or “causes of causes” lie within the domain of social policy and relate to agriculture, commerce, market forces, global covenants, legal frameworks and the environment, among others. In addition, prenatal factors, environments during gestation and factors during the postnatal and early childhood periods may be critically important determinants of later risk (9). Job strain, job demands and decision latitude has also been shown in the Whitehall studies of British civil servants to be additional determinants of CVD risk (10). There is no reason to suppose that these risks are peculiar to one cultural context or one occupation.

The ageing of all populations heightens the importance of CVD both in people of working age and in those who are beyond working age. Given the ageing of the world’s population from 1990 to 2050, we examine in detail the implica-

CVD is the number one cause of death globally (2). More than 80% of CVD deaths take place in low- and middle-income countries and occur almost equally among men and women (3). CVD includes coronary artery disease (including acute coronary syndromes – unstable angina and myocardial infarction), congestive heart failure, stroke, chronic kidney disease, and peripheral vascular disease.

The origins of CVD are located in society. High levels of CVD are found in environments where there is an abundance of unhealthy food, where tobacco smoking is prevalent, where people do not exercise much and where various stresses operate. The dominant risk factors for CVD are either modifiable or not. Non-modifiable risk factors include age, sex, and genetic predisposition. The most important modifiable risks are tobacco use, high blood pressure, altered blood lipids (dyslipidaemia), obesity, and lack of exercise. Systemic hypertension alone contributes to 51% of deaths due to strokes and 45% of deaths due to coronary heart disease (2).

Adults with diabetes have heart disease death rates about two to four times higher than those without (3). The risk for stroke is two to four times higher among people with diabetes (4). Further, one risk factor predisposes to the development of another. For example, between 2005 and 2008, among adults aged 20 years or older with self-reported diabetes in the US, 67% had high blood pressure (4). The American Heart Association also considers diabetes mellitus and its precursor condition pre-diabetes – abnormal glucose metabolism due to insulin resistance as seen especially in the metabolic syndrome discussed later – to be major risk factors for CVD, including kidney disease (5,6). Their increasing prevalence among children and adults in association with rising levels of obesity is of special concern.

These risk factors for CVD also constitute diseases in their own right; hypertension, dyslipidaemia, obesity and abnormal glucose levels are disorders that require medical intervention. These precursor conditions are major targets of CVD prevention in both populations and individuals. They accelerate the progression of pathological processes in vascular, cerebral and myocardial biology that over decades lead to end-organ diseases such as stroke, myocardial infarction and kidney failure, as well as the fatal arrhythmias that account for many of the sudden deaths that occur due to coronary heart disease.

The above risk factors account for the vast majority of coronary heart disease (7). Data from the INTERHEART study convincingly demonstrated that conventional risk factors account for 90% of the CVD risk in all populations (52 countries) where the study was conducted (8).
tions for selected developing countries. By 2030, the median age of the population in much of the developing world will begin to approach that of high-income countries. In several developing countries this will create an age profile much like that of the West, but in so-called “young” countries – those with a higher proportion of people younger than 65 than found in, say, Europe – it will first produce a bulge of people of working age. The world has paid little attention to the chronic disease and disability profiles of the labour force in the developing world. Even less attention has been paid to the economic implications of failing to stem current trends in the development and expression of these diseases.

There is an urgent need to act to stem the tide of risk factors that lead to CVD, to prevent a massive increase in the number of people with end-stage illness. In our estimation, in young countries, while the levels of CVD risk factors are high, a two-decade window of opportunity exists to reduce their progress to end-organ disease. If successful, the future costs of death and disability due to CVD will not become an intolerable burden. We have called this interval “a race against time” to emphasise the importance of taking action now to prevent catastrophic levels of CVD 10 to 20 years hence.

Fortunately, demonstrably effective interventions are already available for individuals at high risk of CVD. These disease prevention and management strategies slow the progress of risk factors and prevent or postpone expression of their most serious end-organ consequences. In addition, affordable public health and other public policy measures can readily be applied at the level of the population to ameliorate the effects of CVD. These measures have been used to good effect in curtailing CVD in countries such as the US, Australia, the United Kingdom and other European nations since the mid-1960s (11-14).

We explore the significance of CVD from both an epidemiological and an economic perspective. In reconciling the epidemiological projections with their likely economic consequences, we address the macroeconomic question: what will be the likely cost to nations of CVD if we do nothing about it? Because there are now effective strategies for preventing and treating CVD, health officials can take decisions about investment in these strategies by considering the costs and benefits of intervention versus the costs and savings of doing nothing.

Assuming that these explorations favour investment in intervention, health officials can make microeconomic choices – such as drug therapy or public health measures or a combination of both – based on cost-effectiveness data. They can choose among alternate investment strategies and determine budgets. We do not provide a detailed costing of the microeconomic implications of specific interventions to reduce CVD in this study. However, we do examine the limited evidence available in relation to both the cost and feasibility of individual and population-based interventions, and locate it within the context of national government macroeconomic decision making. For a complete analysis, we would need a lot more data on costs, especially those that concern the impact of CVD on the workforce.

The document begins by reviewing the derivation of this project from the work of the WHO Commission on Macroeconomics and Health (CMH). It then assesses the global significance of CVD. Five developing countries provide a case study to view the prevalence of CVD in low- and middle-income countries. Next, the macroeconomic implications of CVD are examined. Possible strategies to reduce the impact of CVD are then explored. And finally, we offer an agenda for action.

A1. Origins and rationale of this report

In December 2001, the WHO received the report of its CMH (15). The then Director-General of the WHO, Gro Harlem Brundtland, had established the Commission to produce a comprehensive analysis of the relation between health and economic development. Seven working parties performed this work, and the CMH published a principal report with six supplementary volumes. Jeffrey Sachs, a professor of economics and then director of the Center for International Development within the Kennedy School of Government at Harvard University, oversaw the work of the Commission as its chair. More than 500 experts in health and economics contributed.

The Commission strongly linked health to a macroeconomic perspective, portraying both health and health care as critical elements in country development, sufficiently important to engage the close attention of those responsible for overseeing each country’s macroeconomic agenda. This departs from a conventional view of health expenditure that sees it as a sunk cost, and then assigns decisions about health service spending to the ministry of health, which then makes microeconomic choices about how best to invest the allocation they have received.

Central to the purpose of the CMH report is the question so often asked by governments – why should we invest in health? Competition for public money is intense, even when it is for indisputably humane purposes. If investments in health and health services are to be justified, then the likely yield from those investments should compare favourably with benefits that would follow from the commitment of these funds to other purposes, including education, urban development, public transport, trade and industry, and defence.

Investments in health not only reduce the burden of disease, but also stimulate economic growth, which in turn raises a society’s ability to invest in public health. On the other hand, lack of investment in health, due to overall economic impoverishment, has devastating consequences. The CMH report focused much of its attention on the urgent public health crises of sub-Saharan Africa, a region deeply wounded by HIV, malaria and tuberculosis. It argued that increasing investment in health, harnessing a country’s own resources and drawing on foreign aid when required, is essential if
the world’s poorest nations are to break out of a never-ending cycle of poverty.

The CMH report argued that to improve economic wellbeing, many countries would need to invest more in public health measures, including immunisation, and in primary health care. It also confronted the uncomfortable reality that the necessary investment to achieve health gains and subsequent economic improvement is beyond the capacity of many of the poorest nations. In these cases, donor nations who sense the human, economic and strategic importance of helping these countries out of their poverty must match or exceed the national financial contributions. The report thus called for a manifold increase in donor commitment.

Whatever the source of the increased investments in health and health care, their management necessitates the involvement of ministries of finance and development, and even presidential/prime ministerial commitment to better health. The report called on all nations to consider establishing their own commissions on macroeconomics and health, where ministers of health and finance and their bureaucratic counterparts can meet to establish agendas for health and development. Notably, several countries (e.g., Cambodia, Caribbean Community, Ghana, China, India, Indonesia, Mexico, Sri Lanka and Thailand) have done this, but there are several others that have yet to do so.

We are at a strangely paradoxical historical moment with regard to global health. Old problems coexist with new ones, and solutions to yesterday’s crises provide the vehicle for tomorrow’s threats. For example, under-nutrition remains by far the greatest risk factor for premature mortality among the world’s least-developed countries (16). Improved nutrition has played a major role in health gain and economic development in many low- and middle-income countries. Yet now, excess and unbalanced nutrition threatens the health and wellbeing of many millions of people, a surprising number of whom live in countries that are not affluent. To this must be added one of humanity’s greatest follies — tobacco smoking. The prevalence of tobacco use, which is now declining in developed countries, is increasing in many developing countries (17), bringing with it death and disease.

The major NCDs that account for the vast bulk of the worldwide burden of illness, including CVD, often have their origins in lifestyles and socioeconomic conditions. These conditions reflect both individual and societal choices, the latter made at high levels both inside government and beyond.

We can make a strong case to extend the macroeconomic approach to include a consideration of these disorders. These have a close connection with agricultural policy, food marketing, tobacco production and sale, urban planning, employment, and education. This is not to argue that individual choice is unimportant in relation to lifestyle, but to recognise that the social, educational and economic context in which individuals operate, powerfully shapes the degree to which they can exercise choice.


B

**THE PROBLEM AND THE GLOBAL DATA**

1. **What are the global data?**

CVD is the number one cause of death globally (1). Of the 52.8 million deaths in 2010, ischaemic heart disease (IHD) and stroke killed 12.9 million people (Figure B1). These two diseases accounted for one in four deaths worldwide in 2010, compared with one in five in the 1990s (2). Low- and middle-income countries are deeply affected (3). Low- and middle-income countries almost equally in men and women (3,4). The distribution of IHD and stroke deaths in World Bank income groups and WHO regions in men and women is depicted in Figure B2. By 2030, 23.6 million people are predicted to die from CVD (5). While CVD continues to be the principal cause of death and of much morbidity in industrialised nations (5-7), evident from Figure B2 is the fact that low- and low-
middle income countries are the leading contributors worldwide to CVD deaths.

The largest percentage increase of mortality due to CVD is predicted to occur in the WHO Eastern Mediterranean Region, and the largest increase in number of deaths will be in the South-East Asian Region. In developing countries, CVD represents three-quarters of the mortality from NCDs, and already accounts for 10% of the developing world’s burden of disability (4).

In less economically developed countries, 46% of people who died from CVD-related causes were economically productive, younger than 70 years of age. In addition, 79% of the disease burden attributed to CVD is in this age group (5).

An important parameter used to measure the potential impact of any disease is the disability-adjusted life-year (DALY). The latest Global Burden of Disease (GBD) data shows that IHD was the leading cause of DALYs worldwide in 2010 (up from fourth rank in 1990, increasing by 29%), while stroke-related DALYs ranked third, (fifth in 1990; a 19% increase). Thus, CVD has emerged as one of the major contributors to DALYs (Figure B3).

Projections suggest that for IHD, the mortality for all developing countries between 1990 and 2020 will increase by 120% for women and 137% for men. Predictions for the next two decades include a tripling of IHD and stroke mortality in Latin America, the Middle East and sub-Saharan Africa, a rate of increase that exceeds that for any other region, except for Asian and Pacific Island countries. By contrast, the increase in CVD deaths in more-developed nations, largely attributable to an expansion of the population of older people at risk, will range between 30% and 60% (6).

With regard to stroke mortality and burden among 192 WHO member states from 1970 to 2008, a 42% decrease in incidence was observed in high-income countries (HICs), but more than 100% increase in stroke incidence was noted in low- to middle-income countries. Between 2000 and 2008, the overall stroke incidence rates in low- and middle-income countries have, for the first time, exceeded the level of stroke incidence seen in HICs, by 20%.

Rates of stroke mortality and DALY loss were highest in Eastern Europe, North Asia, Central Africa, and the South Pacific. National per-capita income was the strongest positive predictor of mortality and DALY loss rates (p<0.0001), even after adjustment for cardiovascular risk factors (p<0.0001) (6-8).

B2. Potential reasons for the epidemic
The rise in CVD prevalence is directly proportional to the prevalence of the major risk factors for CVD, such as tobacco use, hypertension, dyslipidaemia and diabetes mellitus.

A systematic review of 139 studies on adult smoking prevalence found that more than 1.1 billion people worldwide smoke, with about 82% of smokers residing in low- and middle-income countries (9). In low-income countries, the leading causes of death among the 1.3 million male tobacco deaths were CVD (0.4 million), in contrast with HICs (10). The data from the global youth tobacco survey, which collected data from youth aged 13–15 years in 100 country sites, revealed an increasing prevalence of tobacco use among adolescent girls (11). Recently, a report from India showed an increasing prevalence of smoking especially among young people aged 15–24 years (12).

Globally, the overall prevalence of raised blood pressure among adults aged 25 years and older was around 40% in 2008. The number of people with hypertension rose from 600 million in 1980 to nearly 1 billion in 2008 (13). In an analysis of the prevalence of hypertension in 2000, Kearney et al calculated that by the year 2025, approximately one in three adults aged over 20 years – 1.56 billion people worldwide – will have hypertension (14). Most of this increase will occur in economically developing regions, and by 2025 three-quarters of the world’s hypertensive population will be in economically developing countries. They predict that the number of people with hypertension in these regions will increase by 80%, compared with a much smaller 24% increase in economically developed regions (14).

Diabetes is rapidly emerging as a global health problem that threatens to reach pandemic levels by 2030. The global prevalence of diabetes in 2008 was about 10% among adults aged 25 years and older (13). The number of people with diabetes worldwide is projected to increase from 377 million in 2012 to 552 million by 2030 (15).

This increase will be most noticeable in developing countries, where the number of people with diabetes is expected to increase from 84 million to 228 million. More than 80% of people with diabetes live in low- and middle-
income countries. Most people with diabetes in low- and middle-income countries are middle-aged (45–64 years) (16).

Obesity has reached epidemic proportions globally – more than 1 billion adults are overweight and at least 300 million are clinically obese. The WHO defines overweight as a body mass index (BMI) greater than or equal to 25 kg/m², and obesity as a BMI greater than or equal to 30 kg/m² (16a). It is a major contributor to the global burden of chronic disease and disability. Obesity often coexists with under-nutrition in developing countries, making the issue more complex (17,18).

Childhood obesity is an emerging problem in the developing world. For children aged between 5 and 19 years, the WHO defines overweight as one standard deviation higher BMI for age and sex, and obese as two standard deviations higher BMI for age and sex (18a). The increasing prevalence of childhood obesity is seen in developing countries: 41.8% in Mexico, 22.1% in Brazil, 22.0% in India, and 19.3% in Argentina. The secular trends in childhood obesity indicate increasing prevalence rates in these countries: 4.1% to 13.9% in Brazil from 1974 to 1997, 12.2% to 15.6% in Thailand between 1991 and 1993, and 9.8 to 11.7% in India from 2006 and 2009 (19). The time trends among women in 39 low- and middle-income countries (1991–2008) indicates an increasing burden of overweight among lower wealth and education groups (20).

As Popkin put it, “dietary changes appear to be shifting universally toward a diet dominated by higher intakes of animal and partially hydrogenated fats and lower intakes of fiber” (21). Physical activity patterns are also equally shifting rapidly toward reduced energy expenditure. Large-scale decreases of prices of some foods and the availability of processed food and the urbanisation of both urban and rural areas are some of the reported key underlying factors in this regard (21).

The rise in CVD incidence reflects a significant change in dietary habits, physical activity levels and tobacco consumption worldwide as a result of industrialisation, urbanisation, economic development and food market globalisation. Unbalanced nutrition, reduced physical activity and increased tobacco consumption are the key lifestyle factors. These risk factors tend to cluster.

B3. The decline of cardiovascular disease in the developed world and the lessons learned

While CVD is a global killer, since the mid-1960s, deaths from heart attack have declined by more than 50% in many industrialised countries including the US, Finland and Australia (22-24), and similar declines have occurred for stroke (25). Data from Canada from 2011 show that heart disease and stroke mortality have declined significantly over the past 40 years – 25% over the past 10 years, 50% over the past 20 years, 70% between 1956 and 2002 (26).

The most recent data from the US indicate that from 1998 to 2008, the rate of death attributable to CVD declined by 30.6%. During the same period, the mortality related specifically to stroke fell by 34.8% (27).

Similarly, data from the European Union (that exclude the Russian Federation and former Soviet republics) show that mortality due to coronary heart disease and cerebrovascular diseases declined by 30% between 1981 and 2004 (28). Figure B4 shows that countries with high-income indices showed a decline in CVD mortality, while low-income countries had no significant change.

The positive effects of action against CVD are readily apparent in industrialised nations, where government agencies, medical leadership, and civic organisations have increased public awareness and widespread action concerning the major CVD risk factors. Campaigns focused on diet, smoking and exercise, together with treatment of hypertension and high cholesterol levels, and surgical interventions when needed, have combined to have a major effect on CVD, reducing its mortality overall, and pushing it back from middle age to old age as a cause of death. Decisions taken at high levels of economic and legislative decision making in several countries have contributed to these positive effects on cardiovascular health, although the specific causal relationships remain uncertain.

CVD in these countries is now concentrated among older people, lower socioeconomic brackets, and racial and ethnic minorities. These higher rates are likely due to disparities that need to be eliminated. Some policy decisions have profound effects even among those without risk factors. For example, recent bans on smoking in public places in many countries have been associated, perhaps causally, with decline in acute myocardial infarction (AMI) risk of up to 17% overall (IRR, 0.83; 95% CI, 0.75–0.92) in exposed population (29).

Bruthans et al reported that 52% of
the reduction in coronary heart disease (CHD) mortality in the Czech Republic between 1985 and 2007 was due to reduction in risk factors, while 43% could be attributed to improvements in treatments (30). According to research from the US and Canada, half the reduction in CHD mortality can be attributed to policy measures comprising of preventive education programs, tobacco control and the encouragement of healthy lifestyles to reduce cardiovascular risk factors in the populations. The other half is ascribed to progress in medical and surgical care, especially recently. This includes invasive and non-invasive methods of treatment concentrated on those with clinically expressed disease, and new and highly effective medications with which to treat hypertension and dyslipidaemia (31-33).

B4. The need and means for control of cardiovascular disease

Life-table analyses on the elimination of specific causes of death suggest that the gains from effective prevention and control of CVD would exceed those of any other cause of death: life expectancy would rise by almost 7 years, but only 3 years if cancer were eliminated as a cause of death (34).

Those who have already had heart attacks and strokes are at high risk of recurrences and death. Thus, secondary prevention becomes an important aspect of reducing CVD impact. This risk can be substantially lowered with lifestyle modifications and a combination of drugs – statins to lower cholesterol (35), aspirin and blood-pressure lowering drugs. However, when such treatment efforts are applied in practice, the percentage of the population attaining treatment targets is dismally small (36,37). In a study from Sweden, 50%–80% of eligible patients received appropriate therapy, and fewer achieved therapeutic end-points (38). By using the IMPACT CHD model (a validated model that combines data on CHD patient numbers, medical and surgical uptake levels and treatment effectiveness), Bjork et al calculated that increasing the proportion of eligible patients with CHD who receive evidence-based treatment could have doubled the observed mortality reduction (38).

Another problem is the availability, and more importantly affordability, of those drugs. For example, nearly 80% of patients in low-income countries, and nearly 70% in lower middle-income countries (LMICs), do not receive medications after heart attack or stroke, and cost is a factor (35). The PURE Study also showed that the use of secondary prevention drugs in LMICs is dismally low (38a). With the availability of generic drugs for CVD, including statins and anti-hypertensives and the potential availability of generic polypills (fixed-dose combinations of multiple drugs: see later), there is renewed interest in the use of drugs for these high risk patients (39,40). All of these methods depend on the identification and treatment of individuals at high risk and cost may limit their applicability in resource-poor settings.

However, the most cost-effective methods of reducing risk among an entire population are population-wide interventions, combining effective risk reduction policies and broad health promotion policies. According to the WHO, these should be the first to be considered in all settings. Population-wide efforts have set out to encourage reduced exposure to risk factors through multiple economic and educational policies and programs.

In essence, the effect of falling CVD mortality rates in the US and similar countries has been to move the burden of CVD and other chronic diseases up the age ladder, with the positive impact of prevention manifest mostly in younger adults in their economically productive years. The less advanced the disease, the greater the impact of prevention, with risk factor reduction in younger people bringing the best results. Hence, the most appropriate markers of a successful CVD prevention program will be a reduction in mortality overall, a shift in the peak burden of disease to older individuals (in terms of both mortality and morbidity), and control of the risk factors that lead to heart disease.

CVD and diabetes are major causes of morbidity and disability as well as mortality. Levels of disability vary. A person with disability may simply be unable to work, or may require the support of family members. In such a situation, the costs to the person and to the society are substantial. In developed countries, social security systems frequently bear much of the burden. In developing countries, where institutional care options are often lacking, and social security is less assured, care most often comes from another adult family member who is withdrawn from the workforce, or from a child, often a girl kept home from school. Indices of disease impact suggest that disability is as great a social and economic burden as premature death, and that CVD accounts for 10%–12% of all the DALYs (13).

The cost of CVD treatment to an individual can be high. Usually after an attack of ACS or stroke, expenditure is sudden and substantial. In the developing world, where 80% of the health...
spending is out-of-pocket, this pushes many families into poverty (41). As seen in the CREATE registry from India, poor people who are admitted with an acute coronary syndromes (ACS) episode frequently miss out on evidence-based treatments because neither the individual nor the public can pay for it, and they experience higher death rates within the first year or two after the attack (42).

The growing burden of CVD in lower- and middle-income countries follows the success of earlier public health initiatives. As Reddy and Yusuf point out, life expectancy in India increased from 41.2 years in the decade 1951 to 1961, to 61.4 years for the 1991–1996 period, thus expanding greatly the population at risk of mortality and morbidity from all chronic diseases, including CVD (43).

In 1971, Omran introduced the concept of the global health transition from communicable diseases to NCDs as major causes of death (44). He described the evolution of dominant societal health problems from infectious diseases and acute illness in the young to the NCDs and chronic diseases, including CVD, which are common in older people. Fox documents a longer history of NCD prevalence in the US, dating back to the turn of the 20th century (45). He also notes a puzzling avoidance of proposals for the prevention of NCDs by health policy leaders.

The epidemiology of the health transition, and the particular role of CVD (including diabetes mellitus) worldwide, has been documented by multiple organisations and institutions. Foremost among these are the GBD project sponsored by the World Bank and the Bill and Melinda Gates Foundation, the Health Sectors Priority Review, also sponsored by the World Bank, and the MONICA project sponsored by the WHO (46-48). The US National Institute of Aging has supported several studies. Investigators from Canada, India, Australia, New Zealand, Mexico, and the US have also made substantial contributions to the growing database (22,49-51). Yusuf et al explored the status of the epidemiological transition from infectious disease to NCD dominance (24). They also drew attention to the explosion of NCDs as a cause of mortality and burden of disease in most of the world (52).

The level of international attention paid to CVD in low- and middle-income countries has not matched its significance. This is, in part, because CVD has few of the features that attract international sympathy or support. CVD is commonly seen as an affliction of affluence occurring in late middle and old age, a regrettable but inevitable feature of growing old, and sometimes associated with victim-blaming as it is associated with smoking, overweight and alcoholism that are defined as matters for which individuals are responsible. This view persists despite the fact that millions of people, especially the poor, die from CVD in their forties and fifties, and the social gradient in CVD is such that it is the poor, not the rich, who are generally most at risk. In countries with emerging economies, the onset of CVD occurs among even younger people (43).

This is evident from the global funding allocation to CVD compared with that to HIV/AIDS (53). Chronic diseases are the least-funded area of donor assistance for health (54). An analysis by the Center for Global Development shows that only 2.3% of the $22 billion per year in international donor assistance in health is devoted to CVD and other chronic diseases, while chronic diseases contribute 69% of deaths (55).

However, there are encouraging signs of international recognition and action. The WHO declared a Global Strategy for the Prevention and Control of Non-Communicable Diseases in 2000 and the Medium-Term Strategic Action Plan (2008–2013) for the Global Strategy for the Prevention and Control of Non-communicable Diseases. Now the 2013-20 WHO NCD action plan has been initiated. The National Programme for the Prevention and Control of Diabetes, Cardiovascular Diseases and Stroke initiated in India in 2008 is an example of a national response.

A special session of the UN General Assembly in September 2011 devoted to NCDs was a major landmark of progress. We will discuss the new initiatives towards the end of this publication, in the chapter “Rays of Hope”.

As mentioned earlier, Raymond showed that the first few decades of the present century offers a window of opportunity for much of the developing world to both manage contemporary chronic diseases in general and CVD in particular, and to respond energetically to the challenge of risk reduction to avoid unparalleled demands of chronic diseases among those aged 60 years and older in the 20 years’ time (56). During these 20 years, while birth rates are falling and the number of people aged 60 years and older has not yet risen to the expected one billion, there will be a period when CVD is causing its principal social problems among those of working age. With decreased infant mortality and no substantial increase in the number of older people with disability attributable to chronic disease, the temporal and fiscal opportunity to set in place preventive and supportive health care systems is substantial. So this period must not be viewed passively: it is an opportunity requiring action of the highest order. We, those who are concerned with and those responsible should really race against time!
REFERENCES


CVD STATUS AND PROJECTIONS IN FIVE DEVELOPING COUNTRIES

C1. Methods and demographic profiles
This section describes the role of CVD in the death patterns of one low- and four middle-income countries, at present and in the future. These countries are Brazil, India, China, Russia and South Africa. We chose these countries to reflect the spectrum of CVD in mainly lower-middle-income developing economies. Russia has the highest rate of CVD among these nations, while South Africa has the lowest. Brazil, India and China are on the cusp of a serious CVD problem (1,2). We chose emerging economy countries with large populations and statistical collections that include social security and workforce data, however limited. We used the data from the 2010 Global Burden of Disease (GBD) study, WHO Burden Of Disease database and data available to us from national databases through our contacts (see acknowledgments at the beginning of the report and elsewhere).

We have used Portugal and the US as two industrialised, high-income comparator countries. Portugal has the lowest CVD death rates in the

<table>
<thead>
<tr>
<th>Population</th>
<th>Brazil</th>
<th>China</th>
<th>India</th>
<th>Russia</th>
<th>S. Africa</th>
<th>Portugal</th>
<th>USA</th>
</tr>
</thead>
<tbody>
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<td>18,66,55,014</td>
<td>1,34,41,30,000</td>
<td>1,24,14,30,000</td>
<td>14,19,30,000</td>
<td>5,05,86,757</td>
<td>1,06,17,000</td>
<td>31,15,91,917</td>
<td></td>
</tr>
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<td>3590</td>
<td>20560</td>
<td>10710</td>
<td>24440</td>
<td>48820</td>
<td></td>
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<tr>
<td>9</td>
<td>5.1</td>
<td>4.1</td>
<td>5.1</td>
<td>8.9</td>
<td>11</td>
<td>17.9</td>
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</tbody>
</table>

European Union, especially among those aged under 65 years. The US has high-quality health and economic data, and has had, for several decades, aggressive CVD management and prevention programs. The process by which the US has driven down CVD rates provides a backdrop for future action on the part of the five study countries analysed.

We obtained CVD mortality patterns for countries from the 2010 GBD study (3) and WHO World Mortality Statistics 2008 (4). To predict CVD patterns at the national level over the coming three to four decades, we used population projections (by age and sex) from the World Bank Development Indicators (5). We used the year 2008 as the base year. We calculated death rates for CVD by age and sex from these tables and applied them to data from the demographic profiles of the study countries. In some instances, we compared these data with data supplied by Dr. Colin Mathers (see acknowledgement) adjusted for underreporting and misclassification. We intentionally and consistently erred on the side of being conservative in our estimates.

First, with regard to mortality, we used only published data on registered deaths and accepted the data at face value for each cause of death without attempting to reclassify deaths into CVD from the category of uncertain causes. Second, we used only current death rates in our projections, assuming that future CVD death rates would not rise. We took this conservative position because we know that the data are weak. The real state of affairs thus would be at least as serious as our calculations portray.

After examining current and projected CVD mortality figures for these countries, and exploring specific topics such as CVD mortality among women, we provide CVD projections for India, based on three sets of assumptions: things getting worse (risk factors increasing); steady state (2008 rates apply); and things getting better (based on the implementation of risk control strategies).

Table C1 indicates the range of wealth of the five study countries, from Russia and Brazil, which are the most affluent among the study countries in per capita terms, to China and India, which are the least affluent. All study countries had significantly lower per-capita gross national income (GNI) purchasing power parity (PPP) than the US and Portugal. The study countries varied in population size from moderate (South Africa) to very large (India, China).

Next, we evaluated the population trends in the study countries to predict what will be the impact of population changes in the prevalence of CVD. Projected changes in population distribution in the developing world due to ageing are staggering.

Figure C1 illustrates the increase in numbers of people aged 65 years and over in more-, less- and least-developed countries, between 1990 and 2050 (6). All three groups of countries have experienced and will continue to experience an increase in the population aged 65 years and over. This is especially dramatic for those countries defined as less- (but not least-) developed. This category, which includes the five study countries, will experience a more than twofold increase of the population aged 65 years and older by 2030 from the baseline of 2010 and a more than fourfold increase by 2050, to almost 1.1 billion people. The number of people aged 65 years and older will increase more slowly in the more-developed and least-developed countries. By 2050, the total number of citizens aged 65 years and older in more developed countries will be less than one-third of the number in less-developed countries.

Turning to the five study and two comparator countries, World Bank figures indicate that population changes will vary across the five study countries in the next 40 years (5). India’s population, on current indications, will increase to 1.6 billion by 2050, and will rival that of China. Populations in South Africa, Brazil and China will steadily increase, and Russia will decrease.

Table C2 compares the current and projected population aged 35–64 years and 65 years and older in the five study and two comparator countries for 2010,
2030 and 2050, expressed as percentage of the total population. The patterns emerging here reflect those outlined for less-developed countries. Two trends stand out. First, while at present the proportion of people aged 35–64 years is much lower in three of the four study countries (excluding China) than in Russia or the two comparator countries, by 2050 the seven countries will have roughly equivalent percentages in this age group (between 35% and 42%).

Second, while all countries show an increase in the numbers of people aged 65 and older, in 2050 there will still be differences among them in the percentage of older people. South Africa and India will remain “young” countries, with only 9% to 14% of their population aged 65 and over. China, Brazil and Russia will both cross the 20% mark for this age group, and the US and Portugal will be more than 20% and 30%, respectively. Here, the distinction between the ageing of the population and increases in the number of elderly people is important. Ageing implies that the proportion of older people is increasing and that life expectancy is increasing, but in “young” countries, this will manifest itself first in increased numbers of young adults and middle-aged people, rather than in increased numbers of older people.

Both these trends reflect different effects of ageing in the five study countries. Because CVD mortality increases as population longevity increases, this will have implications in particular for China and Russia, and to a lesser extent for India, Brazil and South Africa. Two implications of these trends are less well recognised.

The first factor is the dependency rate – the number of people aged younger than 15 years plus those aged 65 years and older (the numerator), who depend on the workforce aged 35–64 for support (the denominator). Dependency will stress the economy of these countries (Figure C3). Across the five study countries, the dependency rates will fall slightly in India and

<table>
<thead>
<tr>
<th>% Population</th>
<th>35-64</th>
<th>BRAZIL</th>
<th>CHINA</th>
<th>INDIA</th>
<th>RUSSIA</th>
<th>S.AFRICA</th>
<th>PORTUGAL</th>
<th>USA</th>
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<td>2010</td>
<td>33</td>
<td>40.68</td>
<td>28.84</td>
<td>41.42</td>
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<td>41.44</td>
<td>39.14</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>38.17</td>
<td>41.23</td>
<td>32.34</td>
<td>43.18</td>
<td>29.02</td>
<td>43.8</td>
<td>37.68</td>
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<tr>
<td>2030</td>
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<td>36.28</td>
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<td>30.66</td>
<td>41.86</td>
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<td>32.88</td>
<td>38.76</td>
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<tr>
<td>2050</td>
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<td>41.09</td>
<td>41.26</td>
<td>38.23</td>
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<td>35.66</td>
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<tr>
<td>% Population</td>
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<td></td>
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<td>2010</td>
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<td>9.83</td>
<td>32.11</td>
<td>21.57</td>
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</tbody>
</table>

South Africa, but it will rise in Brazil, China and Russia.

Second, however, assuming present trends continue, the increase in the working age population in the five study countries will be accompanied by increasing levels of CVD risk factors and end organ disease in that age group. CVD mortality and morbidity is already high in this age group in those countries, and its rise will have serious implications for both health costs and productivity, not just in the next 20 years, but beyond. We explore the labour force implications of current and projected CVD rates later.

C2. Overall CVD experience in the five study and two comparator countries

Table C3 presents a coarse-grained picture of CVD mortality in the study countries using age-standardised death rates for CVD per 100,000 population as the summary statistics for CVD mortality in 2010. We can see that CVD mortality rates in all five study countries are much higher than the comparator countries, the US and Portugal. If we compute the proportions of CVD death rates over total death rates, we can see that the rates are higher in the study countries except India and South Africa.

However, as rates in industrialised countries decline, CVD death rates in middle-income countries are high.

Figure C4 indicates that the age-adjusted CVD death rates are high in the study countries compared to US and Portugal. Projections of the number of deaths attributable to CVD in 2050 are even more deeply disturbing. We applied current age-specific mortality rates to the expected populations of the study countries for the next 40 years. A comparison of the age-standardised death rates due to cardiovascular and circulatory diseases in the five study countries and the comparator countries are given.
C3. Labour force implications

However, these disquieting figures of rising CVD burden in whole populations quickly pale in comparison, when we examine the patterns within CVD death rates relative to age groups. There, CVD in the five study countries is not a scourge of the aged. Rather, it is a burden for the workforce right now, as we write.

C3A. Mortality concentrations among people of working age

Table C4 shows that in four of the five study countries (all except China), age-specific (35–64 years) working age CVD death rates among men and women are significantly higher than in the US or Portugal. Among working-age populations of these countries, mortality rates from CVD are often equal to or greater than rates for the same age group in the US before it embarked on the aggressive CVD prevention and management initiatives that have reduced its CVD mortality. In India and South Africa, women’s workforce death rates from CVD are also higher than those that US women experienced in 1950. Men and women aged 35–64 years in Brazil experience CVD mortality rates similar to those in the US 30 years ago (8,9).

These numbers highlight what may happen in relation to CVD in less-developed economies. The technical capacity of their workforces will improve as less-developed economies grow. Members of these workforces require investment in training, and their loss in midlife through death is expensive to employers.

As Mathers and Loncar reported, “for non-communicable diseases, demographic changes in all regions will tend to increase deaths substantially by 2030, with offsetting reductions in projected death rates in all regions. Population growth and population ageing both act to increase NCD deaths in all regions, although the impact of population ageing is generally much more important than population growth. Population growth has the largest relative impact for low-income countries, and the smallest for lower-middle-income countries” (7).
portion of deaths attributable to CVD among men is approaching or has surpassed that for the US and Portugal, in the case of Russia, India, China and Brazil. Among women, the proportion of deaths from CVD is consistently higher in most of the study countries than in the US and Portugal, indicating that women are more disadvantaged than men relative to their counterparts in the US and Portugal.

Another way of examining working age CVD deaths is to look at the percentage of deaths attributable to CVD rather than to other causes. Figure C6 illustrates this for five of the study countries and the two comparator countries for men and women in the age groups 35–39, 45–49 and 55–59 years.

CVD is already making inroads into the youngest workforce age group (35–39 years) that we studied. In Portugal, CVD represents 11% of deaths among men and women in this age group. The comparable proportions in Brazil are 12% among men and 18% among women, while it is 15% among both sexes in China.

In South Africa, HIV/AIDS is both the principal cause of death at all ages (41% in 2010) and the cause of the most years of life lost (40% in 2010), but CVD of all forms accounted for 13% of all deaths in 2010. The South African picture is further illustrated in Figure C7, which shows that NCDs such as CVD make up an increasingly large proportion of causes of mortality as the population becomes older, and outstrip HIV/AIDS after the age of 45.

Figures C8A and C8B provide yet another illustration of CVD mortality rates in the five study countries. It presents the percentage differences in age-specific death rates among men and women in the study countries when compared with those in Portugal and the US in 2008. Thus as illustrated in figures C8A and C8B, death rates among men in India at age 35–44 years were 230% higher than rates in US, and 725% higher than those in Portugal. For women, the comparable figures are 200% and 600%, respectively. In the case of Brazil, the CVD mortality was 180% higher for men aged 35–44 years than in Portugal. For women, CVD death rates in Brazil were higher (225%–600%) than those of similarly aged women in Portugal.

Although we do not present data beyond age 65 years, CVD deaths appear to concentrate in people of working age (35–64 years) in the four study countries to a degree not seen in industrialized nations. There is variation among countries, and presumably within countries such as India (10) and China, but the sampled countries may not be the extreme. The four countries have 30%–40% of their CVD deaths occurring in people of working age. This is attributable to two factors – first, these countries have higher age-specific mortality rates for those of working age and, second, they have larger populations of working age at risk, and smaller older populations compared with the US and Portugal.

In addition, while CVD occupies a variable position in the death patterns of working age men, in nearly all equivalent age groups CVD accounts for a greater portion of deaths among women than in the US or in Portugal. We address the consistent and striking importance of CVD for women’s health in section C3C.

C3B. Higher morbidity among people of working age

We know that CVD is accompanied by significant morbidity in the developing world (11,12). Due to increasing stroke incidence and other factors, the neurological disability in developing countries like India may soon reach epidemic proportions (13).

The years of life lost due to disability (YLD) estimates for the five study and two comparator countries show that the morbidity due to CVD and other circulatory diseases is more in these five countries than among the comparator countries in the younger ages (Figure C9). We have data from Brazil (14) that...
show that CVD leads to significant morbidity, as evident from the temporary disability benefit claims and early retirement disability payments. Azambuja et al reported that in March 2006, over 300,000 disability retirements attributed to underlying CVD causes were being paid for by the National Institute of Social Security in Brazil (14). This number corresponded to 20% of the severe CVD cases estimated for the population aged 35–64 years. Considering an average retirement period of 3.7 years, the average annual payments computed came as R$1,496 million or US$744 million. Among the temporary disability claims (with an average duration of one year) which were paid in 2004 in Brazil, 8.4% were attributed to CVD, corresponding to 144,984 benefits. Further, the data from Brazil show that in 2004 there were more than 1.5 million admissions attributed to CVD in both private and governmental institutions (14). If we assume 15 days sickness absenteeism per admission, this amounts to 23 million productive days lost.

Hospital admission is only one element of morbidity, and much hypertension and CVD goes undiagnosed and untreated. The data from a community screening study from Trivandrum by Thankappan et al shows that less than 40% of people with elevated blood pressure in the surveyed population were aware of their hypertension, 30% were receiving therapy and less than 10% of the population had achieved good control (15).

C3C. CVD and women’s health
Health experts and the media rarely portray CVD as a women’s global health problem. In developing nations, global health efforts have more frequently, and often exclusively, concentrated on women’s maternal and reproductive functions. Examining working age data by gender, however, raises a caution about that focus and forces a reconsideration of its exclusivity. The impact of CVD on women is both direct, when they experience the illness themselves, and indirect, when their educational and economic circumstances are affected by death or disability due to CVD of family members.

For the five study countries, CVD can be seen as important, or more important, a cause of morbidity and mortality in women as it is in men, especially relative to population structure. For example, in Brazil, China, Russia, and South Africa,
CVD in 2010 accounted for a higher proportion of all deaths for women than for men. India, as we know, still has a high maternal mortality (Figure C10).

If we compare the total number of deaths caused by CVD versus communicable diseases combined with maternal and perinatal problems, (Figure C11), we can see that Brazil, China and Russia have higher number of women dying due to CVD than communicable and maternal and perinatal problems combined.

Referring to Figure C12, although women in the five study countries had lower CVD death rates than men, women in these countries had significantly higher death rates than comparable women in the US and Portugal as of 2010. The reasons may be multifactorial. Inadequate diagnoses and suboptimal management among women might have resulted in poor outcomes (16). Over recent decades, mortality rates in men have steadily declined, while those in women remained stable (16). A lower index of suspicion of CVD among women, both by the population and the treating physician community, might also contribute to the problem.

The differences between women in the five study countries and their counterparts in industrialised countries are also illuminating when measured not as overall death rates, but as the importance of CVD in the mortality patterns of younger women (Figure C13). We can see that the mortality of women aged 15–49 years in the five study countries is much higher when compared with the US and Portugal.

It is also important to view CVD within the context of women’s health in the childbearing years and during the years of family formation and development that follow prime childbearing years. In the study countries, CVD appears to be on its way to playing a much more important part in those years than has been recognised to date. In all five countries studied, CVD accounts for a larger portion of overall deaths among women than conditions related to childbearing, a point that often goes unrecognised due to the stereotype of CVD as a disease only of older women.

Table C5 shows that except in the case of India and South Africa, in the other three study countries at this younger age CVD-related mortality is higher than that due to maternal diseases. In China, the number of CVD deaths among women aged 20–29 years is twice that from pregnancy-related causes. In the case of Brazil it is 1.5 to two times. In Russia, the differences are greater. CVD deaths among women aged 20–24 are three times the pregnancy-related deaths and among women aged 25–29 years, it is five times. These are clear implications for definitions of health risk to women in developing countries. Global health analysts should reconsider the current narrow definition of health risks to women in developing countries, and move beyond an exclusive concern with maternal and reproductive problems to include the profound impact of chronic diseases such as CVD. CVD should become a new priority for women’s health.

CVD deaths among working-aged men also cause havoc for married women by making them widows. Notwithstanding the death toll among women, the higher heart disease rates among young men in the prime of life mean that CVD is creating an equivalent cohort of widows who need support for decades. When 40%–50% of men die before age 64, but only 25% of women die by age 64, the consequences are self-evident.

The study of widowhood and poverty is minimal in the developing world. Data
from the US indicate, however, that the earlier women are widowed, the more likely they are to live in poverty at older ages. In the US, nearly 35% of women widowed at age 55 whose widowhood lasts 6 to 10 years live in poverty, compared to 10% of women widowed at age 65 (17). There are no comparable data for developing countries. The 2001 census data (the latest available as of 2013) from India shows that 58.6% of all widows in the country are younger than 65 years, and 52.8% are aged between 35 and 64 years (18). US Census Bureau data indicate that 66.4% of women aged 60 and over are widowed (19). Data from the WHO SAGE study reveal a large proportion of women are widowed above 50 years (Table C6) (20).

Widowhood increases the all-cause mortality of the bereaved partner to varying degrees. The death of a precedent spouse from any cause increased the widow’s cause-specific mortality for almost all causes, including CVD (21). Urbanisation will matter greatly in this phenomenon. In India, where labour force participation rates among females is only 17.9% in urban areas (22), the loss of men of working age is devastating to household viability. As reported in a study about coping strategies after an acute episode of CVD from India, some households were found to employ “masked” strategies to check the drain on household reserves (23). Children had to discontinue their education or were transferred from private schools to free government schools and families had to move from expensive rental accommodation to cheaper ones. Ninety-three per cent of primary care givers, mostly females who reported an adverse impact of the illness on their employment had to take-up a job for the very first time to support their families (23).

Increased urbanisation is associated with a growing labour force and an ageing (although not necessarily old) population. One of the reasons why urbanisation has been possible is the spectacular increase that has occurred in efficiency of industrialisation, urbanisation, and globalisation and increasing wealth. In particular, higher levels of smoking, overweight, diabetes and high blood pressure will put people at even greater risk than they are at present.

C3E. What will happen if cardiovascular risk factors get better or worse?
The increases in mortality attributable to CVD that we have projected for men and women in developing countries during their working years assume that nothing else gets worse. But, over time, the prevalence of many CVD risk factors is also likely to increase in these countries. In particular, higher levels of smoking, overweight, diabetes and high blood pressure will put people at even greater risk than they are at present.

<table>
<thead>
<tr>
<th>20-24 year age group</th>
<th>25-29 year age group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal</td>
<td>CVD</td>
</tr>
<tr>
<td>Brazil</td>
<td>3.1</td>
</tr>
<tr>
<td>China</td>
<td>1.6</td>
</tr>
<tr>
<td>India</td>
<td>26.4</td>
</tr>
<tr>
<td>Russia</td>
<td>1.7</td>
</tr>
<tr>
<td>South Africa</td>
<td>27.0</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.3</td>
</tr>
<tr>
<td>USA</td>
<td>1.1</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>50 years and above</th>
<th>70 years and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>11.7</td>
</tr>
<tr>
<td>Ghana</td>
<td>25.9</td>
</tr>
<tr>
<td>India</td>
<td>23.9</td>
</tr>
<tr>
<td>Mexico</td>
<td>15.5</td>
</tr>
<tr>
<td>Russia</td>
<td>29.1</td>
</tr>
<tr>
<td>South Africa</td>
<td>23.9</td>
</tr>
</tbody>
</table>

of agricultural production. This has had two major effects, the first being to release a substantial rural workforce that can now devote its labour to tasks in cities. Second, food consumption patterns are changing. Food and Agricultural Organization of the United Nations projections estimate that for example, the incidence of under-nourishment should fall from 17% of the population of developing countries at present to 11% in 2015 and just 6% in 2030 (24). By 2030, average energy intake in the whole of the developing world be nearly 2960 kcal per capita per day and 3070 by 2050 (25).

Urban populations are increasing (Figure C14). Urbanisation though linked with economic growth, is also directly linked to the increase in chronic diseases including CVD, as seen in China (26). Recent data from India also reveals a significant urban–rural difference in the conventional CVD risk factors (27).

Figure C14 indicates that for four of the study countries, there will be a steady increase in the percentage of the population living in urban areas between 2000 and 2050, especially in Brazil and South Africa, but also in China and India; Russia is already urbanised. This reflects, a trend that has occurred for several decades. In Brazil, already predominantly urban, 90.7% of its population will be urban by 2050. Brazil’s urbanisation has occurred at all levels of city size and throughout large sections of the country. By 2050, 76.8% of the population in South Africa will be urban, 77.3% in China, and 51.1% in India. In 1970, there were only three cities with more than 10 million people. Now there are 32, and three of these have more than 20 million (28).

The move to cities is an important factor influencing CVD and its risk factors. In India, risk factor profiles are far more intense in urban populations. Both the prevalence and clustering of cardiovascular risk variables were higher in urban areas than in villages in India, and were higher in the cities than in the towns (29). It is reported in a recent study from India, that a relationship exists between urban living and NCD risk factors.

Among men, urban living was positively associated with smoking, higher BMI, higher blood pressure and lower physical activity; among women, it was associated with low physical activity and higher BMI (30). This is despite the fact that rural to urban migration appears to be associated with both positive (higher fruit and vegetables intake) and negative (higher energy and fat intake) dietary changes as reported from India (31).

In South Africa, a survey of northeastern rural areas found that CVD mortality rates were 40% lower among those aged 55–74 years than South Africa’s overall rates (32). The awareness of hypertension and its prevention, treatment and control remain very low in Africa, even though recent surveys show an increasing prevalence of the disease consistent with the nutritional and epidemiological transition in the region (33).

The latest GBD study shows that as of 2010, the three leading risk factors for global disease burden were high blood pressure (7.0% of global DALYs), tobacco smoking including second-hand smoke (6.3%), and alcohol use (5.5%) (34). Dietary risk factors and physical inactivity collectively accounted for 10.0% of global DALYs in 2010, with the most prominent dietary risks being diets low in fruits and those high in sodium (34). We know from the INTERHEART study that conventional risk factors account for 90% of the burden of CVD in the world (35).

Saturated fat intake, sodium intake (as measured by urinary sodium), and BMI all appear to be rising in developing countries (36), with higher rates in urban areas than in rural. In many countries, urbanisation is associated with steadily increasing rates of obesity (37), not least because that environment enables individuals to respond to market pressures to consume more food than they need and to exercise less than they need. Data from China show that between 1992 and 2002, the prevalence of overweight and obesity increased in all gender and age groups and in all geographic areas (38). The combined prevalence of overweight and obesity increased from 14.6% to 21.8% in China. The annual increase rate was highest among men aged 18–44 years and women aged 45–59 years (38).

During the past four decades, the rates of stroke in southern India and rural South Africa have approximately doubled, whereas stroke rates in more economically developed nations have
decreased. The more distressing fact is that the rates of disability and mortality arising from stroke are at least 10 times greater in medically underserved regions of the world compared with the most developed nations (39).

In a study from India that reported secular trends in diabetes, the prevalence of diabetes increased by 72.3% in 14 years (40). Recent estimation of diabetic status for the whole of India stood at 62.4 million people with diabetes and 77.2 million people with pre-diabetes (41).

The assessment of the direct burden of smoking for CVD, fatal ischaemic heart disease and stroke (haemorrhagic and ischaemic) for all 38 countries in the WHO Western Pacific and South East Asian regions showed that up to 30% of cardiovascular fatalities can be attributed to smoking (42). According to the WHO, each year, the global tobacco epidemic kills nearly six million people, including more than 600,000 who die from exposure to passive smoking. It is estimated to kill more than eight million by 2030, by which time approximately 80% of the deaths would occur in low- and middle-income countries.

In developing countries, risk factors often increase with rising incomes (hypertension and obesity) in part attributable to a changing diet that has more fat, salt and calories, and to increasing body weight and less exercise. CVD risk factors, including obesity, are rising in the developing world faster than they did in western societies (43). The transition is affecting women in particular, and increases in risk factors are more marked among those receiving lower incomes in growing economies than among the wealthy (43).

These factors are generally more common in urban than in rural communities, as we have seen earlier. Over time, experience in Western countries suggests that the more affluent sections of society adjust their lifestyles in directions that favour heart health, with CVD risk then concentrated among the less advantaged (44).

These figures do not mean that CVD is not, and will not be, an increasing problem in rural areas. In rural India, the prevalence of coronary artery heart disease increased from 2% in 1970 to 4.5% in 2000 (45). Still, there are indications that CVD patterns for cities are higher than for rural areas. Although migration from rural to urban areas by sick people seeking care may explain part of the rural–urban gradient, it does not explain much of it. Most is due to changes in diet and physical exercise.

One can estimate broadly the impact of a combination of ageing, a growing urban workforce and rising CVD risk factors on CVD morbidity and mortality. Based on past trends and projected increases in risk factors in China, Moran et al have calculated that there will be 7.8 million excess coronary heart disease events (a 69% increase) and 3.4 million excess deaths from coronary heart disease (a 64% increase) in the decade 2020–2029 compared with 2000–2009 (46). To further examine the likely impact in the five study countries, we estimated future CVD mortality in India based on increased, decreased and steady state CVD death rates. Figure C15 illustrates these three future scenarios for India.

We assumed that due to increase in CVD risk factor prevalence, the 35–64 years age group in India would experience a 2% increase in CVD mortality rate per year over 20 years. Assuming a constant 2% annual increase in CVD mortality rate, the labour force by 2030 will experience 109% increase in CVD deaths. The top line in Figure C15 represents this scenario. Given the certainty of rising risk without prevention, CVD rates will increase, and without preventive disease management these rates will lead to new waves of excess morbidity and mortality.

Returning to the middle line of Figure C15, if we apply the current rate of age-specific CVD mortality rates, still there will be a 42% increase in the number of deaths by 2030, due to demographic changes. Failure to hold cardiovascular risk factor and disease rates to even their current high levels will exact a tremendous price in developing countries, especially in the Indian workforce over the next two decades.

The bottom line in Figure C15 uses 2% annual decline in CVD death rate scenario, which is consistent with the average decline in CVD death rates in US from 1950s to 1980s and as per the rec-
ommendations of several international agencies for control of CVD. We might expect that these rates would apply to countries that instituted similar CVD control programs to those that were associated with these declines in the US. If we assume that India instituted control programs that achieved an annual rate reduction of 2% of deaths among men aged 35–64 years, this would result in only a 5% decline in the number of CVD deaths from 2010 to 2030. The denominator at risk will continue to increase due to demographic factors, and a 2% annual decrease will be cancelled out by a 1.7% annual increase in population growth rate in India. This holds numbers of deaths relatively steady, as indicated by the third and lowest line in Figure C15.

These data illustrate the need to act now to forestall future national catastrophe due to increases in CVD mortality.


37. Ramachandran A, Chamukuttan S, Shetty SA, Arun N, Susairaj P. Obesity in Asia is it different from rest of the...


45. Gupta R. Recent trends in coronary heart disease epidemiology in India. *Indian Heart J* 2008; 60 (2 Suppl B): B4-B18.


The previous sections outlined the potential economic costs of CVD and its risk factors. In this section, we explore the costs of CVD more closely. To develop an estimate of the macroeconomic consequences of CVD, we have calculated the years of productive life lost due to deaths from CVD occurring among members of the workforce, also known as potentially productive years of life lost (PPYLL) (Table D1). We calculated these estimates by applying age-specific CVD mortality rates to the demographic data for the study countries. We have supplemented these calculations by referring to estimates of productivity loss attributable to disability due to CVD as measured in disability-adjusted life-years (DALYs). DALYs are the sum of years of life lost (YLL) and years lost due to disability (YLD), or \( \text{DALYs} = \text{YLL} + \text{YLD} \).

We then created cost estimates relating to outpatient medical and hospital-based care for people with CVD. Data for these costs are difficult to procure from many countries, especially those that are still developing their health systems. We have used data from each of the study countries wherever available but recognise the limitations due to incomplete data.

In addition to the direct costs of medical care, we have sought to develop estimates of the indirect costs of CVD. These are difficult to determine even in countries with well-developed health and social security systems. So once again, we have only been able to produce partial estimates based on few available publications and the data available online. The costs to families of caring for people with CVD vary immensely by social custom and by the extent to which publicly funded social security systems operate.
D1. Potentially productive years of life lost due to cardiovascular disease

Particular interest in this analysis is the potential effect of CVD on the economy, given the importance of CVD among labour force-aged cohorts who may experience premature death and disability. While caution is recommended in assessing the impact of years of life lost, it is possible to estimate the macroeconomic impact of CVD using two measures as already mentioned, PPYLL and DALYs. Costs to the economy can then be extrapolated. Usually costs are broken into direct, indirect, and social welfare costs, the last of which is difficult to estimate.

A measure of PPYLL is most relevant to the arguments in this report because it focuses on loss among the working age population. We calculated PPYLL for the five study and two comparator countries commencing at age 35, assuming a retirement age of 65, and taking the midpoint of each group (35–44, 45–54, and 55–64 years) as the central measuring point. By this means, each death in the first age group counted as 25 years lost (i.e., 65 – 40 = 25, between 40 and 65 years), each death in the second group counted as 15 years lost, and each death in the third group counted as 5 years lost.

We applied these assumptions and the prevailing age-specific CVD death rates to the demographic projections for each country for 2008 and 2050. In Tables D1 and D2, mortality projections assume no change in the rates of CVD or any other illness (e.g., HIV/AIDS) in each country. In the case of CVD, we have already demonstrated that without preventive interventions, risk factors are projected to increase in most of the study countries with possible increases in age-adjusted CVD mortality. The numbers below may be therefore underestimated if current risk factor and treatment trends continue.

Table D1 presents our estimates of PPYLL due to CVD among people aged between 35 and 64 years for the five study and two comparator countries for 2008 and 2050.

As explained in chapter C, calculations for age-specific CVD mortality vary according to the accuracy of published mortality data and also vary because of inherent differences in CVD mortality rates. Thus, when these data are incomplete, our estimates of lost productive life will be low, sometimes considerably so, compared with the real losses and those calculated on the basis of death data adjusted for under-registration and misclassification.

Table D1 shows that the total PPYLL for the five study countries is already high, and will increase from 9.9 million in 2008 to 16.4 million in 2050. Recall that we have assumed stable CVD age-specific death rates, so the increase is due solely to increasing population sizes at risk. Data from India demonstrate an increase in the prevalence in CVD in association with urbanisation (1). The CVD prevalence is likely to rise in India and China in the future, as rural to urban migration is rising in both the countries (2).

Table D1 also shows that PPYLL will increase in three of five study countries between 2008 and 2050 at a much greater rate than rates projected for the two comparator countries.

Compared to 2008, the PPYLL from CVD will increase in 2050 by 15% in the US and decrease by 16% in Portugal, compared with 70% rise in South Africa, 17% in China, 59% in Brazil, and 108% in India. Of the study countries, only in Russia are the estimated PPYLL projected to decrease, largely due to high death rates due to CVD at present and a shrinking population.

Table D2 demonstrates age-stratified PPYLL estimates to calculate which age groups will bear the largest burden of PPYLL. Fewer years of productive life are lost in the five study countries and in the US and Portugal among the youngest age group (35–44 years), consistent with the mortality rates presented for this age group in Figure C9. The increase in years lost between 2008 and 2050 for this age group is huge, particularly in India, where an additional million years of life lost is anticipated in this young age group between 2008 and 2050.

The oldest decade (55–64 years) accounts for the highest proportion of PPYLL for all countries. Projections to 2050 suggest that this age group will continue to have the highest proportion of PPYLL in all five study countries and both comparator countries. In India, we estimate a doubling of PPYLL in all age decades between 2008 and 2050.

In contrast, Russia shows a decline in CVD mortality over these decades, likely due to high premature CVD mortality.
TABLE D2. Potentially productive years of life lost due to cardiovascular disease (CVD) by labour force age group (years) in 2008 and 2050, assuming population trends and current CVD mortality rates continue.

<table>
<thead>
<tr>
<th>Country</th>
<th>2008</th>
<th></th>
<th></th>
<th>2050</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>35-44</td>
<td>45-54</td>
<td>55-64</td>
<td>35-44</td>
<td>45-54</td>
<td>55-64</td>
</tr>
<tr>
<td>South Africa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>15,333</td>
<td>37,902</td>
<td>53,255</td>
<td>22,791</td>
<td>64,597</td>
<td>87,388</td>
</tr>
<tr>
<td>Women</td>
<td>7,266</td>
<td>16,177</td>
<td>23,443</td>
<td>9,840</td>
<td>23,480</td>
<td>33,320</td>
</tr>
<tr>
<td>Total</td>
<td>22,619</td>
<td>54,079</td>
<td>76,698</td>
<td>32,631</td>
<td>88,077</td>
<td>120,708</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>78,733</td>
<td>150,989</td>
<td>229,722</td>
<td>86,788</td>
<td>233,225</td>
<td>320,013</td>
</tr>
<tr>
<td>Women</td>
<td>33,492</td>
<td>64,685</td>
<td>98,177</td>
<td>34,930</td>
<td>94,392</td>
<td>129,322</td>
</tr>
<tr>
<td>Total</td>
<td>112,225</td>
<td>215,674</td>
<td>327,899</td>
<td>121,718</td>
<td>327,617</td>
<td>449,335</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>322,832</td>
<td>511,202</td>
<td>834,034</td>
<td>222,191</td>
<td>545,208</td>
<td>767,399</td>
</tr>
<tr>
<td>Women</td>
<td>178,556</td>
<td>294,842</td>
<td>473,398</td>
<td>125,108</td>
<td>318,883</td>
<td>443,991</td>
</tr>
<tr>
<td>Total</td>
<td>501,388</td>
<td>806,044</td>
<td>1,307,432</td>
<td>347,299</td>
<td>864,091</td>
<td>1,211,390</td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>1,424,460</td>
<td>1,893,654</td>
<td>3,318,114</td>
<td>2,364,028</td>
<td>3,794,130</td>
<td>6,158,158</td>
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<tr>
<td>Women</td>
<td>365,554</td>
<td>652,621</td>
<td>1,018,175</td>
<td>608,338</td>
<td>1,320,053</td>
<td>1,928,391</td>
</tr>
<tr>
<td>Total</td>
<td>1,790,014</td>
<td>2,546,275</td>
<td>4,336,289</td>
<td>2,972,366</td>
<td>5,114,183</td>
<td>8,086,549</td>
</tr>
<tr>
<td>Russian Federation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>241,683</td>
<td>699,436</td>
<td>941,119</td>
<td>212,662</td>
<td>436,523</td>
<td>649,185</td>
</tr>
<tr>
<td>Women</td>
<td>51,057</td>
<td>147,253</td>
<td>198,310</td>
<td>41,310</td>
<td>79,973</td>
<td>121,283</td>
</tr>
<tr>
<td>Total</td>
<td>292,740</td>
<td>846,689</td>
<td>1,139,429</td>
<td>253,972</td>
<td>516,496</td>
<td>770,468</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>118,095</td>
<td>281,670</td>
<td>399,765</td>
<td>138,734</td>
<td>302,720</td>
<td>441,004</td>
</tr>
<tr>
<td>Women</td>
<td>37,395</td>
<td>90,949</td>
<td>128,344</td>
<td>41,753</td>
<td>90,138</td>
<td>131,891</td>
</tr>
<tr>
<td>Total</td>
<td>155,490</td>
<td>372,619</td>
<td>528,109</td>
<td>180,487</td>
<td>392,408</td>
<td>572,895</td>
</tr>
<tr>
<td>Portugal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>1,832</td>
<td>4,677</td>
<td>6,509</td>
<td>1,232</td>
<td>3,759</td>
<td>4,991</td>
</tr>
<tr>
<td>Women</td>
<td>617</td>
<td>932</td>
<td>1,549</td>
<td>397</td>
<td>700</td>
<td>1,097</td>
</tr>
<tr>
<td>Total</td>
<td>2,449</td>
<td>5,609</td>
<td>8,058</td>
<td>1,629</td>
<td>4,459</td>
<td>6,088</td>
</tr>
</tbody>
</table>

D2. Macroeconomic consequences of disability-adjusted life-years lost due to cardiovascular disease

A second way to examine the cost of CVD is to estimate DALYs. One DALY represents the loss of one year of full

rates at present. Significant increases are also projected for the US, but the mortality rate is predicted to decline in Portugal. The decline in CVD mortality in China is surprising, but can be explained by the ageing of the population.


health. This measure includes the impact of premature mortality and disability (e.g., inability to work, prolonged illness). DALY estimates from the WHO and the Burden of Disease study were used in the analysis.

DALYs attributable to communicable diseases and NCDs are shown in Figure D1. According to the WHO DALY estimates for 2008, the age-adjusted burden of NCD is greater in lower and middle-income countries (LMICs) than in high-income countries (HICs), as shown in Figure D2. The projections for 2015 and 2030 reveal that the DALY burden in the HIC will remain the same, but will rise significantly in LMIC (Figure D3).

DALYs lost secondary to coronary heart disease (CHD) in India have been predicted to increase from 7.7 million to 14.4 million among men and 5.6 million to 7.7 million among women from 2000 to 2020 (4). The DALY estimates (not discounted nor age weighted) for CHD are projected to double from 8.0 million in 2000 to 16.4 million in 2030 (5). Assuming that the average individual income is INR $1,000 per annum (an assumption made in the Commission on Macroeconomics and Health (CMH) report (6)), the indirect costs due to CHD-related morbidity and mortality in India will be 22 billion in 2020 and 16.4 in China in 2030.

What is the impact of CVD on payrolls? Disaggregated data on CVD are available for India. It is possible to estimate costs from these data using several assumptions. From the PPyLL data due to CVD in India (2008), we calculated the loss of wages due to CVD. We used the 2012 declared minimum wages for the semi-skilled construction worker as the average for urban (262 INR per day) and the minimum wages for the semi-skilled agricultural worker (183 INR per day) as the one representing rural population (7).

Assuming 30% of the population is due to CVD in 2008 comes to US$224 million in urban areas and US$366 million in rural areas, respectively. The total loss of wages due to CVD is thus US$590 million. The loss of wages will likely increase substantially as CHD prevalence is expected to rise in India.

To summarise, CVD is a major cause of PPyLL and DALYs among five middle-income study countries (Brazil, South Africa, India, Russia and China), with higher levels in 2008 and higher projections for 2050 than two high-income comparator countries (US and Portugal). The loss of productivity is attributable both to the mortality and to the morbidity of CVD, which have substantial potential macroeconomic consequences. Those responsible for macroeconomic decisions in developing countries need to consider CVD when determining their policy agendas.

D3. The toll of disability associated with cardiovascular disease
There are few comprehensive data available on the toll of disability associated with CVD in the developing world, but CVD creates high disability costs for both social payments and household support. For example, data from the Trivandrum Stroke registry in India suggest that the case fatality at 28 days was 27%, with 58% of stroke survivors bedridden or moderately disabled at 28 days (8). The proportion of stroke survivors needing care varied between 20% and 39% in Latin American sites but was higher in rural China (44%), urban China (54%) and reached up to 73% in rural India (9).

In a 2009 study, Harikrishnan et al evaluated 500 survey respondents 3 to 15 months after their first hospitalisation for acute coronary syndrome or stroke, and found that 87% of the respondents had to limit their work activities or experienced difficulty in their work after hospitalisation. Nearly half (45%) reported difficulty in performing activities that required moderate exertion (10). Huffman et al evaluated the macroeconomic impact of first hospitalisation of CVD (acute coronary syndromes, stroke, heart failure, or peripheral artery disease) in four LMICs (Argentina, China, India and Tanzania) and found that 42%–97% of the study population across different socioeconomic positions had difficulties in performing moderate or vigorous physical activity (11). Regarding productivity, 70%–100% of the study population had to decrease their work time. The impact on the household was also significant. Nearly 14% of the household members increased their work time or took up new work to compensate. The percentage of household members who had to stop work or reduce their work time to look after the

The indirect costs of CVD are generally far greater than the direct costs, and it is to be emphasised that it is much more difficult to measure these than direct costs (14). Estimates of the direct costs of CVD and its precursors are useful primarily in giving a sense of the enormity of the burden of these conditions on health systems. But it is arguable that direct costs estimates may lead to underestimation, as they obscure the proportion of people who do not access health care due to costs or accessibility, which is an important consideration in the developing world (14).

Several studies in HICs estimate direct health care costs of CVD and its clinically expressed risk factors. Kiiskinen et al from Finland reported that even when CVD mortality rates fall, costs may remain nearly static (12), in part because technological options for postponing mortality are themselves increasingly costly (see below).

Data from the developed world show that those countries spend staggering amounts of money to cover the costs to CVDs and that those costs are steadily increasing. Data from 2006 show that CVD costs the UK economy £30.7 billion per year. Of the total cost of CVD to the UK, around 47% is due to direct health care costs, 27% to productivity losses, and 26% to the informal care of people with CVD (15). Of the total £14 billion direct health care costs, 72% of this cost was for hospital care, whereas 20% was the cost of medications (15).

The American Heart Association (AHA) estimated that in 2010, the direct health care costs for CHD was $50.8 billion, $18.1 billion for stroke, and $15.6 billion for hypertension (16). The American Diabetes Association sets the direct costs of diabetes at $116 billion in 2007, of which approximately one-third (35%) is due to CVD (17).

Recent projections of CVD costs in the US to 2030 (based on 2010 data, assuming current prevalence) suggest that the total health care costs (direct and indirect) will double in the 18–44 and 45–64 years age groups. The increase in direct costs over these 20 years is estimated to be 200% (projected total of $818 billion) and the increase in indirect costs to be 61% (projected total of $276 billion) (13).

The 2013 annual statistical update (18) from the AHA estimated that the total direct and indirect cost of CVD and stroke in the US for 2009 was $312.6 billion.

Table D3 shows the direct and indirect costs of CVD in the US (16) and the European Union (19) for the year 2006 and 2010, respectively, in International Dollars. These figures indicate that developed economies are spending huge sums of money to tackle CVD. For LMICs, with limited resources and infrastructure, the burden may be relatively greater. Recent World Bank estimates show that health care spending in China, India and Russia currently represents 4%–5% of GDP, in contrast with the US, where health care expenditure is more than 17% of GDP. These data point to the pressures that health systems in developing countries may experience if the incidence and prevalence of CVD (and other chronic conditions) increase.

### TABLE D3. Direct and indirect costs due to cardiovascular disease in the European Union (EU) and the United States of America (USA).

<table>
<thead>
<tr>
<th></th>
<th>CHD</th>
<th></th>
<th>Stroke</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct</td>
<td>Indirect</td>
<td>Direct</td>
<td>Indirect</td>
</tr>
<tr>
<td>EU</td>
<td>Billion Euros*</td>
<td>23.98</td>
<td>12.3</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>EU Billion 2006 Int Dollars</td>
<td>37.17</td>
<td>19.06</td>
<td>7.13</td>
</tr>
<tr>
<td>USA</td>
<td>Billion 2010 Int Dollars</td>
<td>96</td>
<td>11.3</td>
<td>69.8</td>
</tr>
</tbody>
</table>

sick was 12% (11).

As developing countries grow wealthier, disability payments may increase. Even though this can be considered as more investment in social services, ultimately it might become a growing budgetary burden. Thus, the investments that governments make in CVD prevention will likely help reduce the burden of disability and economic costs on society and on the governments themselves.

### D4. Direct and indirect health care costs for cardiovascular disease

Health care costs can be divided into direct and indirect costs. Direct costs are the costs of medical care in relation to prevention, diagnosis, and treatment of disease. They include costs such as ambulances, inpatient or outpatient care, rehabilitation, community health services, and prescription medications. Indirect costs are the costs due to the loss of human resources caused by morbidity or premature death. Morbidity costs represent the value of foregone earnings from lost productivity due to CVD. Morbidity costs include three components: (1) work loss among currently employed individuals; (2) home productivity loss (defined as the value of household services performed by household members who do not receive pay for the services); and (3) work loss among individuals too sick to work (12). Mortality costs represent the value of foregone earnings from premature mortality due to CVD (13).
and political commitment to pay for care increases. The indirect economic costs of CVD in LMICs may be relatively higher than in HICs, in part because of the younger age of onset of CVD, on average.

Acute coronary syndromes and chronic stable angina absorb resources, both private and public, in societies that can and do choose to treat them. Expensive procedures, such as cardiac catheterisation and coronary and peripheral angioplasty, drug-eluting stents, implantable defibrillators, coronary, carotid and peripheral vascular surgery can prolong life and enhance its quality. In many patients, these procedures will be essential to prolong life and also improve the quality of life. The increasing use of these services and procedures will lead to increase in the direct health care costs, as is occurring in LMICs. For example, data from India show that there is an increase of 34% in the number of coronary angioplasties in the 3 years from 2008 to 2011 (20).

A study that analysed the cost of in-hospital treatment of CHD from Brazil reported that the costs of ischaemic heart disease management were INT$3,522 and INT$8,747 for the public and private sectors, respectively (21). The two main determinants of relatively high costs in Brazil are admission with instability of the disease and the chronic pharmacological therapy (22,23). For China, estimates from 1998 indicate that hospital costs attributable to CVD conditions totaled over $9.6 billion, or nearly 20% of all hospital costs (24).

In South Africa, the average cost of hospital treatment of a CVD patient (based on an insurance data sample) illustrates the relative importance of CVD within the cost structure of inpatient care. On average, insurance payments for CVD inpatient care involved a modest average length of stay of 3 days, although the overall length of stay in all types of hospitals was up to twice as long in central hospitals in towns in South Africa’s provinces. However, the cost per admission for CVD was two to three times the average cost in a tertiary care hospital, and six to seven times the average cost of an admission in a regional or district hospital. CVD treatment costs escalate not necessarily because CVD patients are in hospital longer, but because resource consumption for CVD patients is much more intense than for non-CVD patients. Costs per bed day were six times those of the average patient in a tertiary hospital, and 10 to 15 times those of an average patient in a district or regional hospital (25).

There is also an urban–rural divide in health expenditures due to CVD. In urban settings, access to care is often greater than in rural areas. Total patient expenditures for health services in urban areas of India are higher than in rural areas, for both hospital stays and illness treatment, and for services in both government and non-government facilities. Urban households spend more on health care than their rural counterparts do at all income levels, and, except for the poorest, this expenditure is a greater portion of urban household incomes than in rural areas. Patient expenditures are 20% higher in urban than in rural areas, even where government facilities are the locus of care (26).

### Table D4. Out-of-pocket (OOP) expenditures for CVD as a proportion of overall OOP health expenditures, 2007 (29).

<table>
<thead>
<tr>
<th>Country</th>
<th>OOP Expenditures (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>59%</td>
</tr>
<tr>
<td>China</td>
<td>92%</td>
</tr>
<tr>
<td>India</td>
<td>90%</td>
</tr>
<tr>
<td>Russia</td>
<td>83%</td>
</tr>
<tr>
<td>South Africa</td>
<td>30%</td>
</tr>
<tr>
<td>Portugal</td>
<td>77%</td>
</tr>
<tr>
<td>U.S.</td>
<td>23%</td>
</tr>
</tbody>
</table>

D4A. Indirect costs of cardiovascular disease

The effects of CVD on costs extend well beyond the health sector. This is especially true for the five countries studied in this report, where there is a disproportionate impact on the labour force, and hence a greater overall economic price to pay from long-term disability and early death. The aforementioned data of costing of CVD in the UK and US reveals that costs related to loss of productivity and other indirect costs added together will come to almost the same the direct CVD treatment costs (Table D3). In a study from UK, the employment and other costs of informal care provided by the family for CVD patients were almost four times the size of direct health care costs (27).

In a recent assessment of the economic implications of NCD in India...
that was published by World Bank, Mahal et al reported that assuming all caregivers and sick individuals above the age of 15 years were productive, the predicted annual income loss from NCDs was of one trillion INR (US$18 billion) in 2004 (28). More than one-third of all the income losses were due to CVD and hypertension (28).

D4B. Impoverishing effects of cardiovascular disease
CVD treatment is known to be costly. The majority of patients affected by CVD bears the cost of treatment (i.e., through out-of-pocket [OOP] health spending). Data from the study countries show that the OOP health spending for CVD out of total OOP health spending varies from 30% in South Africa to 92% in China (Table D4) (29).

OOP health expenditure frequently leads to impoverishment. The overall positive relationship between proportion of households experiencing catastrophic health expenditure (CHE) and the share of OOP expenditure in total health expenditure has been well established. Three key pre-conditions reported for CHE include: (1) health services that require payment; (2) low capacity to pay; and (3) lack of prepayment or health financing mechanism (30). OOP health expenditures leading to impoverishment is well known (31). One-quarter of those hospitalised in India are impoverished due to OOP health expenditures (31). This high prevalence is particularly relevant, as low socioeconomic status was found to be a major predictor of CHE and the poor have higher risk, tend to be less able to access timely medical care and develop rapidly progressive disease with early and sudden fatal outcomes (32,33).

Xu et al estimated in 2007 that 150 million people suffer from financial catastrophe (defined as annual health spending >40% non-food income) due to OOP spending on health care (30). Mahal et al report that the odds of incurring catastrophic hospital spending due to CVD or injuries in India are about 30% greater compared to communicable diseases that result in hospital stays (28).

Huffman et al assessed CHE and distress financing, or risky financial activities in recently hospitalised CVD patients in Argentina, China, India, and Tanzania (11). Risky financial activities include borrowing money from relatives or friends, taking loans from banks or other lenders, or selling assets related to the patient’s most recent hospitalisation. The authors found that the patients bear high OOP payments after CVD hospitalisation, with lower rates of CHE and distress financing if they have access to private or social insurance and higher income.

Huffman et al found that the 15-month OOP CVD expenditures varied considerably across countries and across income groups within countries (INT$374 [Tanzania, low-income] to INT$2,917 [India, high-income]). These data contrast with 2007 US estimates of INT$1,229 for annual OOP costs after CVD hospitalisation (11).

The group posited that as CVD prevalence increases in LMICs, the household economic impact of CVD may worsen if alternative health spending models that enhance patients’ capacity to pay or without more active policies to prevent or at least postpone the onset of CVD in LMICs are not developed (11).

Impoverishment also results in grossly inadequate treatment. The PURE study, which recruited 153,996 patients from 17 countries, found that the use of drugs for secondary prevention of CVD among patients with coronary artery disease or stroke was highest in HICs (antiplatelet drugs, 62%; β-blockers, 40%; angiotensin-converting enzyme [ACE] inhibitors or angiotensin II receptor blockers [ARBs] 50%, and statins 67%) and lowest in low-income countries (9%, 10%, 5%, and 3%, respectively) (34). The primary reason for these gaps appears to be unaffordability of the medications, even though access, knowledge, and other barriers may also play a role.

D5. Household viability and dependency due to CVD
As noted in the earlier discussion of widowhood (chapter C), death of the breadwinner affects the future of an entire household. This is true whether the individual dies of HIV/AIDS, an accident, or CVD. Using mortality and employment data from India, and assuming an urban household size of 5.8 and a rural household size of 5.5, we calculated that CVD deaths among the 35–64 age group affect as many as 5 million members of Indian households (35). A study in Bengal found that when there is an adult death in a household, a child younger than 2 years has a 12-fold higher probability of death (36).

National expenditure figures can understate the effects of health care costs at the household level. Indian National Sample Survey Organization data from 2007–2008 indicate that Indian households allocate 5%–6% of household income to health care costs (37). Increased morbidity and mortality from expensive illnesses such as CVD may push those allocations upward. In turn, such costs may take household resources away from savings and other areas of consumption and investment.

Some elements of the impact of CVD on households are not easily measured, but their consequences hint at the seriousness of the trends. When a member of an extended family is disabled, there are few systems of care available in developing countries. People with disabilities reside with their families. Frequently, young girls provide necessary care, often at the cost of their schooling. The developing world overall has made great strides in recent years in expanding young girls’ schooling and women’s literacy overall. UNESCO data from 2005–2008 states that the female literacy rate in the developing world was 73% (38). However, if young girls are withdrawn from school to care for disabled adults or to pursue menial labour to supplement the household incomes of their widowed mothers, this chain of success will be broken with potential consequences extending beyond the classroom and the hospital ward.

Data from the central Asian state
of Tatarstan confirm that disability disrupts households. In 2002, among the working population, the second most important stated reason for disability payments to the working population was "looking after patients". Taking care of someone who was ill was second only to being ill with respiratory diseases, as a trigger for being off work temporarily and for receiving direct disability payments. These caretaker roles represented 16% of the entire temporarily disabled population, whose disability was attributable to disease. As disability rises, therefore, its economic effect will be magnified, since disability will also pull caretakers from both employment and education (39). CVD deaths among men of working age also affect households indirectly through dependency. Three-quarters of India’s elderly population are economically dependent on their children. More than 86% of urban elderly Indian women are fully dependent on their children. More than 90% of India’s urban elderly people live with their families, and the proportion is nearly as great in rural areas (40). As the population ages and the dependency rate rises (but now skewed toward the old rather than the young), the impact of the early death of wage earners will be profound, with extensive repercussions on household viability and elderly women. As indicated in Figure D4, dependency will rise between 2010 and 2050 as the number of older persons increase (41).

The greatest proportion of dependents will not be children, but will be individuals 65 years and older in Brazil, China and Russia. The number of persons worldwide aged 65 years or older is projected to reach more than 1.5 billion by 2050, with most (1.2 billion) being in the less developed regions of the world (41). A dependent elder is clearly not equivalent to a dependent child. Older people typically incur more short-term health care costs. In industrialised countries, health care for those over the age of 65 years is three times as costly as for those under the age of 65, and for people over the age of 80 years, three times again as expensive as for those under 80 years. Dependency in old age also exacts other economic costs including social security payments, increasing probabilities of disability, and increasing needs for investments in technologies that enable older people with disability to perform acts of daily living. Data from Canada indicate that dependency on activities of daily living was 11% due to heart disease and 29% due to effect of stroke in a household population 65 years or older (42). The coming tide of elder dependency makes the current CVD problem in developing country settings even more ominous.

The positive news from the developed world is that CVD mortality and risk factor levels can be significantly improved through effective public health and clinical measures. Detailed discussion of this topic and the examples of successful programs that have effectively decreased CVD prevalence is in chapter E.

To summarise, the costs of CVD are incurred both among mid-life and older adults. In developing countries, CVD is a potent cause of death and disability among people of working age. It will become a major cause of disability among older people, whose numbers are set to rise over the next 40 years.
REFERENCES


INTERVENTION STRATEGIES TO REDUCE THE IMPACT OF CVD

In contrast to the grim news about its frequency and social and economic cost, the good news about CVD is that we can do much to prevent and ameliorate it. Those interested in these goals can assess the merits of different forms of prevention, their costs, and their political and economic feasibility. They can relate them to estimates of costs of CVD and its management, and apply them as they see fit. There are very good examples of the benefits of different preventive strategies for CVD — the story of Finland is one (see below).

The terminology about prevention is confusing, and it is important for us to clarify it before we proceed. This confusion arises because public health practitioners and clinicians use the same term — primary prevention — for different things.

Prevention can seek to rid a society of CVD, so that in a long life, CVD never presents as a clinical problem. Public health professionals usually call this primary prevention. It implies the eradication of the primary causes of CVD, that is, of the conditions that produce the risk factors that predispose people to arterial disease.

Alternatively, prevention can aim to postpone the presentation of CVD from young or middle adulthood to old age. This enables the individual to live a full life, participate in the workforce, and experience a healthy old age, prior to the clinical onset of disease. It seeks to reduce risk factors and ameliorate their effects. Public health practitioners refer to this as secondary prevention. However, the clinical literature often calls this primary prevention.

To avoid this confusion, we refer to prevention that aims to lower or eliminate risk factors as community-based prevention, and prevention pursued by clinical treatment of people with elevated risk factors or expressed CVD as clinical treatment and prevention.

When countries that make up the Organisation for Economic Co-operation and Development (OECD) have brought CVD under control, they have used these preventive approaches in combination. Declines in CVD mortality have run in parallel with decades of decreasing consumption of animal fat, decreasing tobacco consumption, and growing community awareness about CVD risk factors and heart health consciousness. As well, medical and surgical treatments have improved in efficacy. These range from pharmaceuticals that lower blood pressure and cholesterol to surgical procedures or percutaneous catheter-based interventions. Most estimates of the effects of these interventions conclude that half the decline in CVD mortality observed in many OECD countries is due to population level changes in risk factors and half to treatment (1). In other instances, changing macroeconomic conditions have contributed to changes in CVD risk (2).

However, the countries that have experienced declines in national CVD mortality have not seen the benefits spread evenly among all groups in their societies. CVD manifests a strong social class distribution, with disease concentrating even more socially disadvantaged, even in countries that have halved overall mortality from CVD (3,4).

E1. Levels of prevention of CVD

Broadly speaking, there are three levels at which to implement CVD prevention.

E1A. Macroeconomic and whole-of-government interventions

This report seeks to locate CVD within a macroeconomic context, positing that CVD has a serious impact on workforce productivity in developing countries. We support that claim by our analyses and those of others of the effect of CVD on workforce productivity, deaths in young adults, impact on women’s health, and widowhood. The financial costs amount to tens of billions of dollars a year in China and India and less in the other study countries, but are so huge as to fully justify the attention of those concerned with macroeconomic policy in middle-income countries (5).

There is another aspect to the macroeconomic significance of CVD, and that is what macroeconomic policy can do to contribute directly to its amelioration. CVD takes its origin from the societies in which it manifests, the major risks having to do with diet, tobacco, work, wealth (or lack of it), education and physical exercise. Officials would be wise to assess the health impact of all public policies that concern diet, nutrition, agriculture, trade, education, tobacco, the physical environment, town planning and transport, on CVD.

Macroeconomic interventions thus include governmental policies in a range of fields in which national treasuries have an interest, and that affect CVD and its risk factors. They are matters that affect a country’s macroeconomic agenda. They include policies and programs such as:

- tobacco production and consumption — including subsidies, taxes, advertising and control strategies, and incentives to grow crops other than tobacco;
- nutrition — including food production, processing and marketing sub-
subsies and taxes, such as those in relation to animal or vegetable fats, and the salt content of foods;
• education – including decisions about curricula in schools and workplaces (e.g., physical education, nutrition and cooking) and assistance in managing stress; and
• urban planning – including that for recreational spaces, transport systems, and city/town/village design that encourages healthy physical interaction with the environment.

Macroeconomic interventions usually derive from ministries other than health (such as finance, transport, education or urban development), and exert their impact on non-health sectors of the population (e.g., dairy producers). They are implicitly political in nature.

An example of a macroeconomic intervention that occurred in parallel with changes in CVD rates comes from Poland. In the early 1990s, after separation from the USSR, heart health steadily improved in Poland, in contrast with other former Soviet republics. Between 1992 and 1994, mortality from heart disease, based on official statistics, fell by 25% from a high in the decade up to 1991 (6). The fall in heart disease deaths coincided with a switch in Poland from consuming animal fats to vegetable fats. This resulted not primarily from health promotion initiatives, but from a government decision to cut subsidies for animal fats and impose taxes, thus raising the price of animal fats to consumers and making vegetable oils more competitive. There followed a 23% decline in the availability of animal fat products and a 48% increase in the supply of vegetable fat products. Margarine manufacturers pushed strongly to sell products with vegetable fat in Poland. At the same time, the government opened markets to oranges, bananas, kiwi and grapefruit year-round. Whether these dietary changes alone accounted for the entire decline in CVD mortality is unclear, but it must have had a major impact. Monitoring of risk factors through the two Polish MONICA centres in Warsaw suggests that between 1987 and 1992 blood pressure and female smoking decreased, but not average cholesterol levels, which were already low (7). Huge discrepancies were noted between official and MONICA 10-year average CVD mortality rates. Nevertheless, macroeconomic policies made it easier for Poles to consume a healthier diet (6). Economic policy alone can sometimes help in promoting heart health, but it is most effective when combined with other social policies, information and legislation.

E1B. Population-based interventions
Governments and other interested agencies direct health promotion interventions at broad populations, addressing the structural and behavioural determinants of health and illness. Unlike macroeconomic policies that have to do with revenue and general government outlays, these interventions have an explicit health goal. They bring awareness of the value of good health, and create pathways to it for as large a population as possible. The methods used include media projects and advocacy together with enabling social programs about how to maintain health and reduce or avoid risk. For CVD, these comprise information and other programs addressing the risks of smoking, the value of smoking avoidance, excise and taxes aimed at reducing smoking uptake and intensity, restrictions on smoking in public places and smoking advertising and smoking cessation treatments; the causes of high blood pressure, including consumption of salt (8), and the benefits of control strategies; the causes of hyperlipidaemia and dietary recommendations; the importance of good nutrition and the dangers of obesity and warnings about diabetes; the importance of physical activity in weight control and cardiovascular health; and stress reduction in the workplace. It has been shown that the curative-based medical model is insufficient to reduce the use of tobacco, and that this will only be achieved by prevention and public health measures (9). An immense literature documents the steady reduction in tobacco consumption in developed countries that has followed the introduction of comprehensive tobacco control strategies involving public education, tobacco excise and tax, bans on advertising and restrictions on smoking in public transport, restaurants, bars and places of assembly. Health promotion has been essential to this process.

We can consider tobacco taxation as a macroeconomic intervention because of its relation to major sources of national revenue in many countries. Jha et al examined the economic consequences of instituting comprehensive tobacco control strategies (10). These strategies include an imposition of excise duty on the sale of tobacco to citizens. Tobacco taxation can raise substantial revenues. Jha et al calculated that in China, a 10% increase in cigarette tax would decrease tobacco consumption by 5%. It would also increase tobacco revenue by 5%, sufficient to finance a package of essential health services for one-third of China’s poorest 100 million citizens (10). This work gives the lie to the myth that only rich countries can afford to introduce tobacco control strategies.

A good example of tobacco legislation leading to positive effects in CVD control is the banning of smoking in public places. Reports from Italy showed an immediate reduction in acute myocardial infarction admissions after the smoking ban introduced in 2003 (11). In a systematic review, Myers et al found that banning of smoking in public places lead to reduction of myocardial infarction by 17% and the reduction was most apparent in the young and non-smokers (12).

The Framework Convention on Tobacco Control, adopted at the World Health Assembly in May 2003, requires signatory countries to promote public awareness using multiple communication methods (13,14). As smoking is avoidable, the habit and its initiation and perpetuation could yield to a successful combination of macroeconomic, population based and health worker initiatives. This initiative, which entered into force in 2005, is receiving strong international support with more than 179
parties (as of October 2014) associated with it currently.

Excessive dietary salt may be a major cause of raised blood pressure, and a reduction in salt intake may reduce the CVD burden (16). A recent modelling study from India found that reducing intake by 3 g/day over 30 years (~0.1 g/year, 25% reduction) would reduce annual myocardial infarctions by 350,000, strokes by 48,000 and deaths by 81,000 among Indian adults aged 40–69 years (17). The WHO 25/25 goals also identifies salt restriction as an important measure.

Many countries, including Japan, Finland and the UK, have reduced the amount of salt being consumed by a combined policy involving the food industry in decreasing the amount of salt added to foods, clear labelling on food products, and increasing public awareness of the harmful effects of salt on health (18). In many developing countries, most of the salt consumed comes from salt added during cooking or from sauces; therefore, public health campaigns are needed to encourage consumers to use less salt (18,19). Initiatives such as World Action on Salt and Health (WASH) which is a coalition of health professionals from different countries may help in this regard (18).

In relation to nutrition, agriculture and food production, governments have developed hundreds of policies and programs in developed countries to modify dietary consumption of fat, especially animal and trans fats. Their potential for benefit is huge because they aim at the entire population, seeking to achieve small reductions in risk for everyone. The effects of these small reductions in risk can be substantial when multiplied across entire populations (20). For example, Oster and Thompson estimated that a minimal (1%–3%) reduction in dietary saturated fat in the US would reduce coronary heart disease events by 30,000–90,000 a year, thus avoiding between $4.1 billion and $12.7 billion in medical and productivity costs (21).

Chapter 5 of The world health report 2002 uses published evidence to assess a wide range of health promotion interventions highly pertinent to CVD. The chapter carefully presents the costs and imputed benefits of these programs. The analyses should prove useful to countries concerned to invest wisely in achieving control over CVD (22).

From Finland comes a major example of population-based dietary interventions that have had beneficial effects on CVD prevalence, although in ways perhaps not originally anticipated. Finland experienced high death rates from heart disease after World War II. Public concern about the frequency of heart attack deaths led to a regional experiment to prevent them – the North Karelia Project, which began in 1972. Because of the association of high serum cholesterol levels and heart risk, cholesterol in the diet was one of the major targets of the prevention program. Puska et al developed a series of community-based strategies designed to change dietary behaviour. These included media campaigns, collaboration with the food industry and agricultural policy changes (23).

The initial impact was a decrease in CVD incidence in the North Karelia region compared to a control region. However, the differences between the two regions – and between North Karelia and the rest of Finland – decreased after the first 5 years, mainly because people in the control region also changed their behaviour (23). As dietary preferences changed, the food industry perceived new opportunities and developed products with less oil. Agriculturists developed a type of rapeseed that grew well in the cold northern climate of Finland. The local rapeseed oils sold well and cooking with vegetable oil became popular in Finnish kitchens, so that the market proportion of unsaturated fats increased. Food producers reduced the salt in their products. The availability of products lower in salt and saturated fats made it easier for people to comply with health messages.

North Karelia and Poland demonstrate the ability to change diet through macroeconomic and health promotion interventions. Mauritius has used nationwide programs since 1988 that have employed price, policy and educational efforts along with community education and changes in cooking oil from palm to soy. Although obesity increased slightly over the first 5 years of the program, other CVD risk factors including blood pressure, cholesterol, smoking and lack of exercise all changed favourably (24).

The evidence in relation to population-based dietary interventions to reduce CVD is nonetheless mixed. Regional population-based CVD control programs in the US have not been successful (25). A critical appraisal of community-based interventions by Ebrahim and Smith was not encouraging (26).

Kääriöinen et al reviewed more than 50 community-based interventions that have ameliorated CVD in developed countries for their applicability in low and middle-income countries (27). They question whether the evaluative studies have been large enough to detect small changes. They also ask whether the extent of the intervention (the dose), compared with the massive advertising budgets of the food industry, has been anywhere near large enough to effect substantial change. For programs to succeed, the authors, mention the necessity of community endorsement, adequate intensity of intervention, corroborative national policy development, evaluation, and where warranted, generalisation and international sharing.

Trans fats are another risk factor for CVD. A 2% increase in energy intake from trans fats has been associated with a 23% increase in cardiovascular risk. Denmark has shown that it is possible to eliminate all industrial trans fats from food items (28). But moves toward the elimination of trans fats, for which no lower dose has been shown to be safe, are incomplete. The American Heart Association recommends limiting trans fats to <1% energy. The US Food and Drug Administration labelling rules allow products containing <0.5 g trans fat per serving to claim zero trans fat. Many products with 0.5 g trans fat per
serving, if consumed over the course of a day, may approximate or exceed the 2 g maximum recommended, while claiming to be trans-fat “free” (29).

Pérez-Ferré et al analysed trans-fat regulation in the economically developing world, taking Mexico as an example (30). They reported that the food industry and government resisted the need for regulation, and there was no organised health or consumer lobby to counter this. The authors argued that this will be likely to be the case in other middle-income and low-income countries too.

Another issue is coexistence of under-nutrition and malnutrition-related NCDs, as seen in China and India, for example (31). In these countries, under-nutrition and its problems exist in some areas (rural areas, urban slums), while some regions have problems of over-nutrition. This can lead to problems in implementation of programs in improving the dietary pattern in the community as a whole.

In many developing countries, serum cholesterol levels often increase as diets change, although the dynamics of agriculture and food production differ from country to country. Kim and colleagues described the rapid nutrition transition observed in South Korea since the 1970s and presented a detailed analysis of the social environment and nutritional behaviour of South Koreans over the study period (32). Although there has been a large increase in the consumption of animal products and a fall in cereal intake, fat intake has not increased markedly and obesity rates have not risen as much as in similar countries. Government-directed national efforts towards maintaining elements of the traditional Korean diet, which is lower in fat and has generous portions of vegetables, together with widespread instruction in healthy cooking, are credited with the benefits. The authors suggested that other developing countries might learn powerful lessons from South Korea (32).

It is reported that consumption of foods complying with the criteria for a front-of-pack label could contribute moderately to cardiovascular risk reduction via influencing blood lipids (33). Nutritionists and economists have estimated the costs and benefits of mandatory labelling of all prepackaged food with nutritional information. They predicted that labelling would save the US $4.2 billion over 20 years through health gain at a cost of $1.5 billion. The health ministry in Canada calculated that labelling would save the country $5.3 billion in direct and indirect health costs over 20 years, at a cost of $300 million to industry. In Australia and New Zealand, mandatory nutrition labelling is projected to prevent 400 deaths a year, with savings to the health system between $47–$67 million (34). Given that in countries such as India and China currently most people consume homecooked food, the benefits of food labelling may not be immediately evident. However, with advancing nutritional transition and easy availability of processed foods in many urban locations in these countries it will be imperative for these countries to address trans-fat reduction with energetic vigour.

Psychosocial stress is increasingly being recognised as a risk factor for CVD (35,36). Stress reduction by meditation and yoga has shown to control risk factors like hypertension and reduce the CVD risk (36).

When we evaluate population-based macroeconomic and health promotion approaches to changing smoking and diet, causal relationships are difficult to establish because opportunities for randomised controlled experiments are few. And yet, using other analytic and descriptive approaches, in the developed world, associations among reductions in smoking, animal fat intake, salt and excess carbohydrates, with reduced rates of CVD mortality are consistently evident. These are so notable that many governments continue to embrace strategies that reduce exposure and attempt to influence individual behaviour, and the WHO continues to include these strategies as an important and cost-effective element in comprehensive prevention initiatives (37).

E1C. Provider-based prevention
As risk factors accumulate and become more prominent in the population, CVD prevention must shift to more individualised interventions, including the treatment and counselling of individuals in relation to risk factors such as smoking, hypertension, dyslipidaemia, diabetes, and obesity (38–42). The more risk factors a patient has, the more intense interventions must be, to prevent end-organ CVD. In many instances, health authorities and physician associations have developed clinical practice guidelines that specify best practice for the management of patients at high risk or with established disease. The treatment of risk factors, as indicated, constitutes prevention or postponement of end-organ CVD.

Trials of therapy begun even when end-organ disease (myocardial infarction, the onset of congestive heart failure, or renal insufficiency) is overt demonstrate strong benefits for patients (43,44). Clinicians can slow the rate of progression of early coronary or cerebrovascular disease or congestive heart failure by medical and surgical intervention. Moreover, we now know that a combination of medicines and behaviour modification can prevent much of the end-organ damage of diabetes. Results from clinical prevention trials of pharmacological treatment for hyperlipidaemia show a substantial reduction in both ischaemic heart disease (IHD) and cerebrovascular disease in those at high risk (39).

In practice, however, reducing risk in the clinical setting is not straightforward. The 2005 WHO-PREMISE study of 10,000 patients with coronary heart disease (CHD) and cerebrovascular disease in 10 low- and middle-income countries, showed that unhealthy lifestyles and high levels of risk persisted in many despite best efforts. About 47% of patients had at least two or more modifiable risk factors (smoking, physical inactivity, hypertension, diabetes or hypercholesterolemia). Thirty-five per cent did not follow a heart-healthy diet and 12.5% continued to use tobacco. A significant proportion of patients did not receive appropriate medications – only 29.1%
of the CHD patients used statins. The study concluded that there are many missed opportunities for prevention of recurrences in those with established CVD in low- and middle-income countries (45).

Another recently published study of more than 15,000 patients from 39 countries across the globe reaffirms the above fact when it showed that even though most of the patients were on drugs for secondary prevention, the majority of the patients were not achieving the targets of secondary prevention (46).

Hypertension is the precursor for two-thirds of strokes, half of coronary disease, and three-quarters of congestive heart failure. Although hypertension is an appropriate target for all three types of prevention, once established it is most responsive to pharmacological intervention (47).

Analyses of 316,000 men observed for years in MRFIT, a study conducted in the 1980s, showed strong graded relationships between serum cholesterol above 4.65 mmol/L (or 180 mg/dL), systolic blood pressure above 110 mmHg and diastolic blood pressure above 70 mmHg, and mortality due to CHD (48). MacMahon et al conducted a meta-analysis of nine major observational studies of 420,000 patients and found that a sustained 10 mmHg lower diastolic pressure was 56% fewer coronary events and 37% fewer coronary deaths, coronary deaths, and other CVD for men and women of all ages down to a level of 115/75 mmHg (51). In an analysis from an Asian and Pacific cohort study conducted in the age groups <60, 60–69, and 70 years and older, Lawes and colleagues showed that if systolic blood pressure were 10 mmHg lower, the epidemiologically expected mean reduction in risk of stroke would be 54%, 36% and 25% respectively at these ages, and the risk of IHD would be reduced by 46%, 24% and 16%, respectively (52).

Simple interventions, such as dietary sodium restriction, have been found to not only reduce blood pressure, but also to cause reduction in all CVD endpoints, as evidenced in the TOHP I and TOHP II studies (53). A recent position statement from the Pan American Health Organization/WHO Regional Expert Group on Cardiovascular Disease Prevention through Dietary Salt Reduction concludes that the benefits of salt reduction are clear and consistent, and has called for a population reduction in salt intake to prevent strokes, heart attacks and other cardiovascular events (54).

As a starting point for treating individuals with elevated risk factor levels, hypertension control should be the forerunner. A clinician can enter an individual’s world through this door. Hypertension is easy to identify and universally recognised as a determinant of risk. Beyond the individual, the clinician can use the measurement of blood pressure to recruit families to broadly based prevention programs. The clinician can then add other treatments or life style modifications aimed at other risk factors as necessary.

Dyslipidaemia plays a causal role in vascular disease and reduction in cholesterol levels has been found to reduce both IHD and stroke rates (55). In MRFIT, there was a fivefold increase in coronary mortality between the lowest and highest decile of total cholesterol (48).

Individual assessment of cholesterol level is expensive because it involves blood tests and individual patient access to them. Because of its responsiveness to dietary manipulation, hyperlipidaemia is an appropriate target for all three types of intervention. However, research suggests that it is especially sensitive to pharmacological intervention (56).

A meta-analysis of the major primary prevention trials conducted before 2008, using statins, showed a significant reduction in major coronary events and reduction in all-cause mortality (57). These studies were spread among patients with normal or high cholesterol levels. Despite the impressive benefits observed with total cholesterol and low-density lipoprotein cholesterol (LDL-C) reduction attempt to increase high-density lipoprotein cholesterol (HDL-C; “good cholesterol”) by drug therapy has not been successful.

To simplify the management of individuals who require medication for CVD, Wald and Law proposed a combination pill (polypill). They proposed that the polypill would contain hydrochlorothiazide or atenolol or enalapril to lower blood pressure, simvastatin to lower cholesterol, together with folic acid (to reduce homocysteine levels) and aspirin to inhibit platelet function (58). Wald and Law reasoned from clinical trial data that if everyone aged 55 and older took the pill (age being the strongest predictor of CVD risk) in high-risk populations, together with younger patients at high risk or with established CVD, the polypill could reduce IHD events by 88% and stroke by 80%. In the UK, despite recent declines in CVD mortality, 96% of people who die of CVD are aged 55 years and over.

Wald and Law argued that treating everyone aged 55 and older (or younger if at high risk) is justified, without measuring risk factors before treatment or monitoring the effects of treatment. The intention is to shift the distribution of the principal risk factors in the population, reducing the population mean value for each and reducing the risk of the entire (“sick”) population. They estimated that one-third of people aged over 55 taking the polypill would benefit, gaining an additional 11 years of life free of IHD events or stroke. The number of patients needed to treat to achieve a substantial benefit was just three. The estimated rate of side effects was 10%, but serious consequences would be much rarer (58).

But the age of 55 and older suggested by Wald and Law for at-risk popula-
tions in economically advanced nations may be too high in the developing economies described in this report as by this age, the disease or its risk factors may be well established.

Several versions of the polypill have been successfully developed by pharmaceutical companies from India (59). The combination of drugs is reported to be free of pharmacokinetic drug-drug interactions among the ingredients, and their bioavailability well preserved (60).

One polypill (Polycap – Cadila Pharmaceuticals, India) has been tested in India using a factorial trial to assess its impact on risk factor reduction and it was found to efficacious and safe (61). Another study which was done under the auspices of the WHO in Sri Lanka, reported that both the patients and treating doctors found the polypill to be safe and effective (62).

The UMPIRE trial, conducted in Europe and India, tested polypill in patients who already had established vascular disease (63). Recently published results from UMPIRE showed that the polypill increased the adherence to therapy by 33% (64). As we know, adherence to therapy is a major problem in treating chronic diseases, especially in the developing world (65).

There are other studies currently in progress on different polypill versions with different combinations in different countries, among them are Kanyini-GAP, conducted in Australia, and IMPACT, which is ongoing in New Zealand. TIPS2 is another trial that tested a high-dose polypill against the low-dose polypill, developed by another Indian pharmaceutical company. (As all these polypills use generic versions, they have a huge market potential for scaling up).

A recent critical analysis of the effects of the polypill reported that while patients at higher risk showed reductions in systolic blood pressure of up to 28.8 mmHg and in LDL-C of up to 54 mg/dL, correlating with 62% and 60% relative reduction in risks of CVD and stroke, respectively, the reductions among patients at lower risk were modest (66). Polypill therapy is expected to be cost-effective. In a recent trial from the Netherlands, polypill therapy was found to be cost-effective, which indicates that it can be useful even in the developed world (67). Even though polypill strategy has its own benefits, the difficulty to titrate the dosage of drugs and the need for withdrawal of the combination pill in response to side effects of one of the components is a concern. Further research is needed to provide a definitive verdict in the case of polypill therapy.

Obesity is now a worldwide epidemic, with massive increases in prevalence in countries of many different levels of development. This has led to a surge in the incidence of the metabolic syndrome, which often precedes diabetes, and to the recognition that in younger individuals this leads to a more rapid development of CVD endpoints. The 2007–2008 estimates of age-adjusted prevalence of overweight (BMI >25 kg/m²) was 69.4% in the US. A recent study from India found the prevalence of metabolic syndrome in an urban setting to be 45% (68).

Clinicians have shown that the metabolic syndrome is reversible. Weight loss and change in caloric intake can abolish insulin resistance, hypertension, hyperlipidaemia, and the other metabolic disorders that define this syndrome. Diabetes prevalence falls following weight loss and dietary change. Tuomilehto et al. showed that lifestyle changes in a middle-aged Finnish diabetic population led to a reduction in the prevalence of diabetes by 58% over 4 years (69). The average weight loss was 4.7%. We know that reducing the prevalence of diabetes also reduces the risk of CVD. For example, the landmark UK Prospective Diabetes Study, carried out in the 1970s and 1980s, showed that strict drug control of diabetes led to a reduction in complications, such as CVD (38).

The impact of weight gain on the incidence of diabetes is profound. Estimates of increasing risk of diabetes over 10 years for a 1 kg increase in weight range from 4.5% to 12% (70). In the US Nurses Health Study, over 90% of type 2 diabetes appeared to be preventable if the nurses maintained healthy body weight and attended to lack of exercise, poor diet, smoking, and alcohol (71). The absolute risk for a major coronary event in a person with diabetes without known coronary disease is nearly as high as that of a person without diabetes who has established heart disease (72).

Despite frequently being available, fruit and vegetable consumption is well below the desired levels in the developing world. The INDEPTH–HDSS study evaluated six Asian countries (73) and found inadequate fruit and vegetable consumption in 63.5% of men and 57.5% of women.

A meta-analysis of cohort studies has shown that increased fruit and vegetable intake in the range commonly recommended is associated with a reduced risk of stroke. The authors conclude that this data provide strong support for the recommendations to consume more than five servings of locally available, seasonal and inexpensive fruit and vegetables per day, which is likely to cause a major reduction in strokes (74). Another meta-analysis has shown that fruit and vegetable consumption is inversely associated with the risk of CHD (75).

There are data to show that changing diet following a heart attack may confer a benefit. The Lyon Diet Heart Study compared a Mediterranean diet with a prudent Western diet among patients who had survived a first myocardial infarction, although the results of this study have been criticised. The authors claimed that the diet reduced death, non-fatal myocardial infarction, and various other endpoints including stroke, over the 4-year follow-up period (76). The PREDIMED study also showed that a Mediterranean diet is beneficial (76a).

Two post-myocardial infarction trials, one in India and one in the UK, have also demonstrated beneficial outcomes based on dietary advice (77,78). The Framingham Study had earlier observed the independent value of dietary fruit and vegetables (79). The British study looked at three regimens – fat reduction, enhanced fish intake, and increased...
Clinicians need to build smoking cessation programs in many different countries to develop coronary events a decade earlier than non-smokers do, and patients with heart attacks who resume smoking are four times as likely as those who stop to sustain a second one. Smoking increases worker absenteeism and reduces productivity, both of which improve after cessation (81). CVD reduction is one among many powerful arguments that have led to successful tobacco control strategies in many different countries and to recent concerted international action. Smoking is responsive to all three types of interventions although macroeconomic and health promotion initiatives tend to be most effective. Nonetheless, while concentrating on prevention, we note that the effects of smoking cessation are strong and immediate, and clinicians need to build smoking cessation into clinical risk reduction. Clinicians should urge all people who smoke to quit and assist them in doing so to reduce their chances of CVD. Those at elevated risk because of age or other risk factors should receive the most energetic and supportive encouragement to quit.

Even though the patient will be most receptive (regarding advice regarding smoking cessation) following an admission for an acute coronary syndrome (“teachable moment”) the percentage of patients receiving an advice regarding smoking cessation is very low. It is found that a simple advice by the physician will improve the quit rates and offering and providing assistance by physicians to quit smoking generate more quit attempts (82). But the availability of organised smoking cessation programs in the developing world is very limited (82) and these may need to be strengthened. However, it is also much easier for a smoker to quit when there are social restrictions on smoking and a prevailing attitude that favours not smoking.

E2. Practicalities of cardiovascular disease prevention
Policies for people at low risk of CVD should seek to diminish or avoid tobacco use, to favour the production and use of vegetable oils over animal fats, and to encourage physical activity especially in urban areas. The goal is to alter the factors that determine negative behaviour patterns within the population of those not yet at risk or at minimal risk. However, people at high risk will also benefit from these policies, finding it easier to change their behaviour if there is social support for doing so.

Once there is clinical evidence of markedly elevated CVD risk factors, treatment is required. High-risk groups require more resources for prevention per person than do large-scale interventions with those at lower risk. The economics of these two approaches are not straightforward, however. A low-risk group, being large in number, can rapidly multiply an intervention of low unit cost to create a large total cost. About half of all CVD mortality occurs among those with low levels of identifiable risk, and it is to this population that health promotion addresses its efforts. The 10% of the population who have the most risk factors for CVD contribute less than 50% of disease events including death from IHD though this has been questioned (82a).

Primary health care is the form of health care delivery preferred for the clinical treatment and prevention of CVD, a preference based on both equity and efficiency. The CMH Report refers to primary health care as close-to-client services (83). Primary care provides local health services to communities, and is essential for high-quality management and clinical prevention of most illnesses. In comparison to the low cost of a primary health care infrastructure (including drug therapies, where necessary), the expense of comprehensive medical and surgical interventions to treat established end organ CVD is very high. The World Health Report 2008, subtitled Primary health care – now more than ever, recognised the renewed importance of primary care in the new age (84).
them, no government or interest group should think otherwise. Clinical prevention aimed towards individuals at high risk requires an enduring, lifelong, relationship between the patient and the person treating them, unlike single or discrete repetitive interventions such as vaccination or treatment for short-term illness.

Besides drug costs, infrastructure and management systems are important components of clinical secondary prevention programs. A comprehensive primary care service depends on a distribution system for the supply of diagnostics, pharmaceuticals and educational materials. The treatment of CVD risk factors also requires trained personnel, simple screening tests and cheap and effective interventions. Components include:

- a stable government and a civil society, creating a context in which it is safe to visit a clinic, and where disease and medical disorders are free of stigma and individual blame;
- a national, regional, and/or urban primary care system, together with equitable financial arrangements for care;
- public educational programs available in print and other media;
- a national and regional supply distribution system for diagnostic tests and medications;
- enough trained health professionals to do the work and continuing education for all of them;
- reliable, affordable, and predictable access to effective medications;
- and a referral system for those with clinically expressed end organ disease that may require hospital or special care.

Almost as a parenthetic comment, we note that there is another important aspect of clinical prevention to keep in mind. That is the natural history of deferred CVD. In the US, the number of heart failure admissions tripled from 1979 to 2004. Lloyd-Jones et al also reported that though IHD mortality was reduced in the last two decades of the last century, it was accompanied by an increase in hospital admissions for congestive heart failure, a long-term sequel of IHD, by 155% (86). Congestive heart failure is now the most common cause for hospital admission among older US people and is an emerging epidemic.

**E2A. The costs of clinic-based risk factor interventions**

What would a basic, first-step clinical intervention program look like and what would it cost? It is extremely helpful if a country has a publicly funded primary care clinic system as the starting point for clinical interventions directed against CVD. This provides an excellent base for the detection and recruitment to treatment of those at high risk. It can also serve as a springboard into the community to boost health promotion initiatives, which can address both social structural impediments to heart health (local attitudes to smoking, provision of adequate recreational space) and individual behavioural determinants (attitudes towards nutrition, obesity, tobacco smoking).

*The world health report 2002* addressed the costs of clinic-based risk factor interventions and provided a range of helpful analyses relating the evidence of effectiveness in relation to probable costs in a range of countries (22). The proposed working model was as follows. A clinician would check each patient medically four times a year and a health educator would meet each patient at least once a year. Those managing the patients would perform annual laboratory tests. Health managers would link the clinical preventive approach to population-based strategies relating to tobacco, exercise and diet (including salt). Contrary to expectations perhaps, many of the interventions yield an excellent return on investment.

The report goes on to state that the most attractive strategy is the combination of salt reduction at a population level through legislation or voluntary agreements, with health education through the mass media focusing on blood pressure, cholesterol and body mass, plus the implementation of an absolute risk approach to managing CVD risks (22).

Cost analysis of a similar CVD prevention strategy as described above using a regimen of aspirin, statin and antihypertensive agents in those people at high cardiovascular risk (people with a 10-year cardiovascular risk equal to or above 15%), or those patients who have suffered a previous cardiovascular event, found it very cost-effective. They calculated that by providing such a regimen to the above groups between 40–79 years of age, we can possibly avert about 20% of cardiovascular deaths in the next 10 years, with 56% of deaths averted in people younger than 70 years. With effective management, the average yearly cost per person of implementing such a regimen has been estimated to range to a modest cost from US$0.43 to US$0.90 in low-income countries and from US$0.54 to US$2.93 in middle-income countries (87).

We endorse this general approach. In the basic version we propose, doctors or other health workers would measure the blood pressure of everyone who uses health clinics for any reason at all (“opportunistic screening”) – upper respiratory infection, arthritis or well baby check-ups. They would invite patients identified as hypertensive to participate in a risk factor modification program, of which smoking cessation advice and help would be central. The clinicians would also invite family members for screening. Possibly, if finances and facilities permitted, a single, non-fasting blood drawn for blood glucose, cholesterol and creatinine levels would provide a more complete risk profile and permit drug therapy to be fitted to the patient’s condition. By way of an example, such a blood test would cost 200 INR ($4) in India. We recognise that even these costs may not be tolerable to the poorest of the poor in the developing world.

In relation to the pharmacological treatment of hypertension, multiple, cheap medications are now available and it has been shown that they are...
all equally effective (50). The availability of generic drugs is a blessing to those needy in the developing world. Many of the pharmaceuticals in nearly every class of drug used for CVD are now off-patent. The Indian government, for example, has enacted certain rules to control the prices of essential drugs which include most cardiovascular drugs (88).

For hypertension alone, the clinician might prescribe a thiazide diuretic and a dihydropyridine calcium-channel blocker or an ACE inhibitor. Thiazides and calcium blockers or ACE inhibitors would cost about $1 per person per week in India. If cholesterol were also elevated, clinicians could add a statin. In India, the prices of statins have come down. For a week’s maintenance dose of simvastatin of 10 mg, it will cost only about a dollar per week in India.

We estimate that a regional purchaser could negotiate price reductions of 75% now and 90% in the near future, especially as more and more of these drugs come off patent. Tax exemption to these drugs will also help. In India, medical shops run by government agencies have tax exemptions, so that poor people get the drugs at a lower cost. Clinicians might also consider adding aspirin, which is very cheap, to those at the highest risk and when it is not contraindicated.

With the addition of more drugs to the patient’s regimen, the marginal costs and benefits become critically important. In the UK, Marshall examined the additional benefit bought by adding drugs sequentially to achieve a reduction in CVD risk. If clinicians in the UK were to add simvastatin to a regimen of antihypertensive agents, $250,000 would purchase a reduction of 1.2 coronary events in those patients at a 15% 5-year risk of a coronary event. The same amount of money, spent on aspirin for a much larger group of individuals at a 5-year 10% risk, could prevent 30 such events (89).

Incremental cost-effectiveness calculations are critically important in settings where money to spend on interventions is very limited and must be used to the best community effect. The total cost for treatment using antihypertensive medications, aspirin and statins, would be about $2 per person per week in India.

The use of a polypill strategy will reduce the cost further. This is possible because the drugs used in the polypill (e.g., which was tested in UMPIRE study) – simvastatin, hydrochlorothiazide or atenolol, aspirin and lisinopril are off-patent drugs. Other polypills will also be similarly priced.

Pharmaceutical treatment of CVD, given the large number of individuals who need it, poses a major problem for many countries. This is similar to the problem faced by countries that need antiretroviral therapy for patients with HIV/AIDS. Seeking external aid to achieve coverage may well be an appropriate response for many countries faced with a mounting toll of CVD.

Health service administrators and others can use available cost-effectiveness data to calculate the likely benefits that would accrue from such programs in their country. These therapies, as already stated, may be outside the range of financial possibility for many citizens and governments in low-income countries. Nevertheless, they are likely to be within the capacity of affluent citizens to pay, especially those who, unless treated, might consider highly expensive treatment (including surgery or angioplasty) when their CVD manifests. For these individuals to pay for their own treatment may be acceptable if national health service financing recognises the need of others for support. This is desirable for equity and achieving social justice goals through health service provision.

Two other elements of a basic clinic-based prevention program for CVD are important. First, continuing education in relation to CVD prevention for the professional staff would be essential. This need not be expensive. Local health professional associations could incorporate it into ongoing professional education programs, assisted by health professionals from OECD nations and elsewhere volunteering their time. Unfortunately, the medical and allied health curricula in less economically advanced countries often treat preventive aspects of chronic diseases lightly, or not at all.

Second, and in parallel with the intervention, a public awareness campaign would enhance enrolment and participation. The facts about CVD, and how citizens, government and the private sector can prevent and treat it, should be communicated to everyone in the communities under study using all affordable communication methods and strategies as described in the health promotion literature. Government’s role as a communicator, and not only a provider of care, is critical for each country’s health future. Health experts need to inform society about the growing magnitude of CVD and the factors that lead to it. Informed citizens can then press for administrative and governmental support, through policy and legislation, to assist citizens to make wise pro-health choices.

Whatever choices those responsible for health systems and macroeconomics make for CVD prevention, an essential parallel activity is outcome assessment, best conducted by independent assessors. Those implementing these programs should also measure the economic costs and benefits. National or regional programs of prevention should include enough money to measure effectiveness, say 15–20% of total program budgets. Governments and health professionals can then identify unsuccessful programs early and alter or stop them, or they can enhance successful programs and then transplant them with due adaptation to where they are needed next.


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F
FROM ANALYSIS TO ACTION

The preceding analyses have demonstrated the size of the problem that CVDs present both now and for the next 20–30 years in countries that have not yet attained the levels of affluence. It is much worse than that experienced in the US and similar economically advanced nations. These latter countries have moved through the worst of the CVD epidemic, at least as a cause of death before the age of 65, although it remains a major cause of death and disability in later years. What is required in sociopolitical terms to make such an achievement likely in economically developing countries, beyond the technical insights that underpin prevention and treatment in their various forms?

The changes that have occurred with the end of the Cold War provide us with many challenges and opportunities. Civil societies have become more common. Originally “civil society” was used to refer to open societies and open economies where the rule of law, popularly endorsed and enacted through democratic institutions subject to the will of the people, governed both societal and economic life. Currently, the term has taken on a limited meaning to embrace that group of community-based, not-for-profit, non-governmental institutions or movements that engage in either service provision to communities or public advocacy. This definition explicitly excludes the private sector from the institutional mix constituting civil society because it makes profits (1). This is not our meaning, nor do we believe it is an accurate definition of the term. By civil society, we mean the uncoerced free association of the totality of law-abiding individuals and institutions present in open societies and open economies irrespective of their economic rationale or role (2).

For the past few decades, peoples in every geographic region have been experiencing more open economies and more open societies. Since 1955, Freedom House has produced assessments of the progress and occasional regress of political rights and civil liberties in nations around the world. Between 1979 and 2012, the percentage of countries that are free or partly free, in the sense of there being respect for civil liberties, wide scope for open political competition, and freedom of the media, rose from 65% to 76%. The percentage of the world’s population living in free nations rose from 35% in 1973 to 43% in 2012. In 1986, there were fewer than 70 elected democracies in the world; by 2012 there were 117 (3).

These trends present a challenge and an opportunity for the management of chronic diseases including CVD in developing countries. The challenge occurs in those societies that are not open, where reaction remains firmly in the hands of a few who ration information and resources as they see fit. By contrast, in civil societies, two elements create a great opportunity.

First, information is widely available, whether issued by governments, dug up by journalists, unveiled at professional meetings, or accessed on the internet. There may be questions about its quality, but not about its quantity. Second, people have the ability to organise, assemble, and speak out, and not only to do so quietly at the ballot box once every few years. An open media, increasingly based on the internet, and freedom of assembly, together with a competitive political playing field, enable constant public challenge of anything that compromises deeply held values or hopes. Knowledge can become the motivation for the creation of new organisations (e.g., disease advocacy associations), or the spur to widespread public demand for change (e.g., as the ranks of widows grow). As knowledge drops into a civil society pool, the ripples of change move outward across the societal surface, touching and changing diverse sectors (4).

Citizens and citizen groups can apply pressure to governments to create pro-health policies through taxes (e.g., an excise tax on tobacco) and regulations. When government in a civil society institutes such measures in response to community advocacy, it is possible to counter the argument that they are interfering with individual liberties. The restrictions, taxes, health information or other social instruments put in place are in response to pressure from an informed electorate, and not imposed paternalistically by a “big brother” government or a “nanny state”.

It is also true, however, that in free societies people can choose not to comply, especially where individual behaviour change is concerned. In a centrally controlled political system, if the optimal programmatic solution to the erosion of health status is physical exercise, the system can mandate exercise. In an open society, policymakers can mandate to their hearts’ content, but the people may or may not respond. The levers of change are no longer in the hands of ministries, but individuals. However, governments may create environments where individual pro-health decisions
become easier choices, and the pressures of interests that promote unhealthy food or tobacco smoking (5) can be restricted through government action, mandated by the electorate, and incentives offered for health promoting behaviour, mediated through the social and economic environment.

There is a final element necessary to institute change in CVD in developing countries – trust. If the public is to accept interventions that favour healthy choices and limit their freedom, through tobacco control strategies, food subsidies and pricing, including those applied to alcohol, trust is crucial. Society must have grounds to trust government agencies, health officials, health care professionals, academia, and the media. If the public is to trust information on different health risks (less animal fat, less salt, more fish) and treatments (medications for hypertension), the information must come from respected professionals, empowered consumer groups and professional bodies. The public must see the information as being free of political bias and of conflicted interest. Promotion of vegetarianism may receive support from many religious groups who have influence in the society.

Trust also operates as governments build relationships with new partners, including business, organised labour, social security systems, and insurers, which may all be critical partners in the fight against a rising tide of chronic disease. Developing country ministries or departments of health will need to become more permeable to private initiative, which currently accounts for half of all health care resources, as well as public concern (4,6). There is a realisation about the role of private health care systems in developing countries like India. The Indian government has initiated programs that encourage public–private partnerships in many health-related areas.

What does this mean for health care systems under conditions of a growing chronic disease burden, especially of CVD, and spiralling death rates within the working age population? To the extent that civil society exists in a country, clearly, facts about CVD will become public knowledge and lead to public action, particularly among the best-informed at-risk population – urban families.

In societies with well-informed citizens, this in turn may lead to the emergence of interest groups, such as heart associations or anti-smoking lobbies. These groups represent a health system opportunity. Such interest groups and voluntary organisations, ubiquitous in civil societies in developed countries, provide both an outlet for information and public education, and a means for channelling individual concern into productive societal change. Interest groups can campaign for greater action, including support for all individuals to have equitable access to essential medications that can substantially reduce risk.

But the problem of CVD in the developing world lies in areas such as slums (both rural and urban), small rural townships and villages. Literacy levels in these areas are low, so the penetration of information about CVD will be minimal compared to the developed world. This may perpetuate health inequities. Therefore an approach that reaches from the highest levels of macroeconomic decision making to individual citizen volition, assuming realistic responsibility for their health, has much to commend it.

Interest groups can also be important conduits by which health systems can influence other sectors of government in support of health. They can carry the message to ministries of finance and other executive offices that the public values increased resource commitments to health care. In so doing, they can influence non-health settings to consider health impacts, and can do so perhaps at times more effectively than government advocates for health care budgets. Alongside this, they can also educate the public, motivate behaviour change and encourage compliance with therapeutic programs that prevent life-threatening incidents. Their presence, and their access to information and to large numbers of concerned individuals, can result in heightened demands for government responsiveness and accountability.

In relation to chronic diseases such as CVD, governments in open societies will increasingly find themselves held accountable for reversing rising risk factor prevalence and death rates by coalitions whose constituents are most affected by CVD. The interest groups may also lobby them heavily to provide high-tech care. The citizenry will not just generally expect accountability; it will specifically demand it. For government public health leaders, the existence of private interest groups and professional organisations dedicated to chronic diseases will result in public expectations of health policy and health service responses that are focused and articulate.

In the case of CVD, where risk factors are well recognised and a range of effective interventions available, there will be strong pressure on governments to respond. There is a growing literature on the process of translating knowledge of the environmental determinants of NCDs, especially CVD, into effective health policy. In civil societies, people do choose, but unless we take care in attending to the environment, broadly defined, then healthy choices become difficult choices (7). Part of the challenge is to provide timely and convincing information about these interventions, including the opportunity cost of intervening and not intervening, to those who are making public policy decisions day by day.

These responses require governments to move beyond the bounded notion of health systems and health departments populated by health professionals who operate solely in terms of their technical expertise. There has been a tradition in developing countries that governmental public health departments focus on controlling communicable disease threats (engaging in environmental control, running mandatory immunisation campaigns, isolating disease outbreaks to prevent their spread) and on improving access to clean water and healthy food.
However, with chronic disease, macroeconomic decision making and individual behaviour and its social determinants are the principal concerns. In the future, public health departments will need to respond to NCD threats by participating in economic debates to help establish agendas that take due account of these health needs of the community.

Building relationships with new partners may prove difficult for some. But the need for change is also an opportunity. The opportunity allows for the building of new coalitions for health and health care that are more powerful and effective than those that exist at present. Partners who speak from the podium of business, labour, and finance can raise the visibility of health care in arenas where policymakers make decisions about fundamental economic priorities and policies. That would indeed be a novel opportunity for global health.

F2. CVD as a macroeconomic challenge
The first edition of this report grew out of the commission on macroeconomics and health. Our argument is that in low and middle-income countries, NCDs should be included along with communicable diseases when health is elevated to a matter of macroeconomic interest. We have shown that CVDs warrant inclusion because of their immense impact as causes of death and disability, especially among people of working age and among women. CVD hits the workforce directly and indirectly and undermines family viability in many developing countries, and these blows will fall more heavily in the future. Retired people will experience CVDs as a cause of morbidity as population’s age and the ranks of those aged 65 years and older increase dramatically in the next 20–30 years. Health services and social security systems will be especially affected.

We commend our report to the attention of those many interested individuals in countries that are going to bear the brunt of CVD in the coming decades. They can do much to ameliorate CVD, but it is a race against time: strategies to reduce risk exposure and treat those at high-risk need immediate application to achieve their best effects, in the workforce now and with older citizens in the next two decades. Therefore, countries need to develop CVD control strategies now to maintain health and reduce costs. CVD control should therefore be an important part of a comprehensive macroeconomic approach to development. Economic benefits will flow from CVD prevention because of the immediate impact prevention will have on workforce mortality and morbidity.

What can prudent decisionmakers, such as those who work in the ministry of health and the ministry of finance, expect to gain from a CVD prevention program? Existing cost-effectiveness and economic data need to be refined country by country (7). A prudent course of action would be for every civil society to examine carefully the cardiovascular health impact of macroeconomic decisions that pertain to agriculture and food production and marketing, and tobacco control (8). Participation in international efforts to curtail tobacco consumption has been justified in multiple analyses, and one of the benefits of smoking cessation is an immediate reduction in CVD risk (9).

We should approach this problem aiming for a long-term solution not as a problem of health care, but as a challenge in which health is intertwined with economics, education, culture, and human behaviour. The old mould of public health as a health sector function must be set aside and replaced with one that sees health as a critical investment that reaches deeply into the economy and larger community to involve both the leaders and the levers with influence on the origins and solutions to the problem.

F2A. Who should be at the table?
A national CVD effort must involve health leadership, both from public health and from the medical services professions. But also (and equally) needed at the table are:

- opinion leaders from all levels of business, in recognition of the impact of CVD on the workforce and because some sectors (e.g., food production and sales) are important for CVD control;
- representatives from cooperatives, organised and unorganised labour;
- private financial institutions to address capital needs for health infrastructure;
- public financial institutions (ministries of finance and central banks; as the future of labour productivity is at risk, the costs of doing nothing will be tremendous, and the policies that might be needed to alter the costs of risk behaviours are under the control of public finance);
- social security system managers and private insurers, who will pay the direct price of disease and disability;
- representatives of the education sector at all levels (as prevention must start with behaviour change and behaviour change starts with knowledge and attitudes);
- community groups with particular levers on the problem (women’s groups, health lobby groups, athletic groups and clubs);
- communications firms or agencies, whose expertise will be an asset in any effort to change opinion, attitudes and behaviour; and
- professional associations of doctors, national regulatory agencies of doctors eg. medical councils, medical research donors and regulators.

F2B. What should be on the agenda?
The national coalition brought together under the auspices of the national macroeconomic commission if it exists, or the mechanisms developed in response to the UN General Assembly resolution or a similar agency if the above does not exist, will need to address the CVD problem in all its dimensions, from roots to consequences. Their discussions will not always be easy, and will risk a clash of vested interests.

An agenda would need to list the problem initially. This would involve:

- determining its severity and spread;
identifying its roots in the demography, culture, and risk behaviours of that country; and

• identifying the policies, norms and economic and social structures that support those risk behaviours.

Attention could then turn to what has been done about the problem to date, and how much success or failure has followed. There should be careful study of what the citizenry know about CVD and what they do not know and should know.

It would also be important to focus on the vested interests that may aid or hinder the creation of a solution to the problem. These vested interests may include competing economic priorities (e.g., tobacco companies), private-sector practices not conducive to health (5), health services themselves, and the structure of social security payments and the various social support systems (informal) that operate in that country. These will be difficult discussions and will raise questions of resources, costs, and burden sharing. They will require private and public collaboration and compromise. It would be desirable to enunciate all barriers, including those that are economic, that have to do with trade, that are cultural and political, and those that are due to prevailing regulatory systems.

The group should then consider the costs of not acting – in human health and economic terms. Identifying political costs both of acting and of doing nothing may also prove to be helpful.

F2C. What resource pools do national leaders need to mobilise?

We know that resources in the developing world are limited (10), so they must be properly used. If these discussions are to be more than theoretical, those in charge of resources must put them on the table. These people must be represented in, and see themselves as co-owners of, the solution. Resources concern and include more than just health budgets. They extend to those in ministries of social security and social welfare, industry, finance, labour, youth affairs, planning, housing, and agriculture. They also extend to the private sector, both private industries and financial houses.

Philanthropy is also a potential resource. In many middle-income countries, private philanthropy is emerging as a powerful force in community development and in health and education. Domestic philanthropy (and international, to the extent that it is interested) is a pool to be assessed and involved.

Where a country receives international development assistance, the group in charge of NCD prevention and control should consider that as another resource. By and large, however, international development agencies do not have health assistance policies that are conducive to public-private collaboration in chronic disease control. In most cases these activities will entail a change of policy regarding the definition of health care and what constitutes health leadership.

But, if a national macroeconomic commission and its opinion leaders can organise a coalition, define the problem, commit to a solution, and mobilise local resources to begin to implement the solution, bilateral and multilateral agencies will have little option but to follow.

Different countries may take different approaches, combining population-based prevention and clinical prevention in unique ways. But to do nothing will put governments and their leaders in the untenable position of accepting high levels of death and disability both now and in future.
Despite the alarming rise in the burden of CVDs in lower middle-income countries, several well-established strategies and approaches to prevention provide us with rays of hope. Strong advocacy by several non-government organisations working together in the NCD Alliance (1) and concerned academics such as the Lancet NCD Action Group (2) with the support of many nations and the WHO culminated in a high-level meeting of the UN General Assembly concerning NCDs. Held in September 2011, the meeting led to the formulation by the UN and WHO of comprehensive goals and plans aimed at reducing the global burden of NCDs. In addition, the governments of the five countries examined in this report have signalled their intentions by either formulating programs or policies aimed at NCDs or by taking steps towards implementation of such policies.

This chapter highlights and analyses the potential impact of such initiatives.

G1. International initiatives
UN initiatives
G1A. High-level meeting of the UN General Assembly

This was a landmark in the global fight against CVD and other NCDs. The Political Declaration on the prevention and control of NCDs was adopted on 16 September 2011. This was just the second time when the UN had organised such a meeting on a health matter (the first being in relation to HIV), signifying the growing recognition of the importance of NCDs in the health agenda of the Member Nations. The gathering comprised high-ranking officials from 120 nations; several private players; international organisations, such as the WHO; and non-government organisations, such as the NCD Alliance and World Heart Federation (as a member of the NCD Alliance) (3).

The declaration called on the UN General Assembly’s 193 Member States to draw up voluntary national plans to tackle NCDs and committed the WHO...
to establish a global surveillance network for a set of global targets before the end of 2012 to monitor trends and report progress on activities to reduce death and disability from NCDs (4). The declaration recognised the immense health and economic burdens imposed by NCDs on all nations, especially low- and middle-income countries (5).

The declaration incorporated recommendations made by government and non-government organisations and stressed research, development and international cooperation in controlling NCDs (5). The UN Declaration implied that an operational partnership to this effect should be in place by early 2012. In addition, it proposed that existing mechanisms should be strengthened to assure cooperation within the UN system itself; that the active involvement and cooperation of the UN Development Programme, the Food and Agriculture Organization, UNICEF (the UN International Children’s Emergency Fund), and the International Labour Organization were vital to achieve the necessary multisectoral approach demanded by NCDs (5).

Following the mandate from the UN High-level Meeting, the WHO consulted with Member States and other stakeholders in 2012 around a set of ten suggested targets. This process culminated in a formal Member State consultation at WHO in Geneva during 5–7 November 2012 (6).

The session was attended by representatives of 119 Member States and many non-government organisations. The revised WHO discussion paper, detailing a comprehensive global monitoring framework (including indicators) and a set of voluntary global targets for the prevention and control of NCDs as well as a report summarising the results of the discussions in each of the regional committees, were considered by Member States (6). The indicators and global targets agreed upon by consensus were integrated into a draft WHO Global Action Plan for the prevention and control of NCDs for 2013–2020 (6).

This plan was submitted to the 66th World Health Assembly, held on 27 May 2013, where the Member States adopted an “omnibus resolution” on NCDs (7). This resolution included the endorsement of the WHO Global Action Plan for the prevention and control of NCDs from 2013 to 2020 (8).

The action plan comprised a global monitoring framework which, when adopted collectively by Member States, UN organisations, other international partners and WHO, will set the world on course to achieve nine globally agreed targets for NCDs. The plan also detailed ways for reducing premature mortality from NCDs by 25% by 2025 and a monitoring framework including 25 indicators to track mortality and morbidity, assess progress in addressing risk factors and evaluate the implementation of national strategies and plans (8).

The WHO developed the draft terms of reference for a global coordination mechanism through a consultative process and the document was accepted by the World Health Assembly in May 2014.

WHO is also tasked to provide technical support to Member States and to develop a limited set of indicators to inform on progress made with the implementation of the action plan in 2016, 2018 and 2021, during the 68th, 71st and 73rd World Health Assemblies (8).

The UN general assembly at its high-level review meeting on July 10 and 11, 2014, took stock of the progress achieved in the prevention and control of NCDs since September 2011. The meeting re-affirmed the commitment to address the global burden and threat of NCDs.

G1B. World Health Assembly endorsing new health goal (“25 by 25 goal”)

The 25th session of the World Health Assembly took place in Geneva during 21–26 May 2012. It endorsed a new health goal pertaining to NCDs — to reduce avoidable mortality from NCDs by 25% by 2025 — the “25 by 25 goal”. This builds on the UN General Assembly 2011 political declaration on NCDs though it is seen by many as highly ambitious (9).

G1C. UN Conference on Sustainable Development – 2012 (Rio+20 – “The future we want”)

The tight connection between the forces that threaten climatic sustainability and challenge equitable global development and the risk factors for NCDs and CVD in particular, meant that the Rio+20 agenda was of great interest to NCD control advocates. The Rio+20 conference acknowledged that the global burden and threat of NCDs constitutes “one of the major challenges for sustainable development in the twenty-first century”.

The conference agreed to recommend strengthening health systems with the goal of providing equitable, universal coverage and to promote affordable access to prevention, treatment, care and support related to NCDs, including CVD and diabetes (10) not only for reasons to do with human health but because of the contribution that these changes could make to human flourishing and global sustainability more broadly.

G1D. UN Resolution on Global Health and Foreign Policy – 2012

The 2012 UN resolution on global health and foreign policy also acknowledged the need to continue to promote, establish or support and strengthen multisectoral national policies and plans for the prevention and control of NCDs. The resolution recognised the importance of universal health coverage in national health systems in this regard.

WHO initiatives

The WHO has been active for decades in proposing programs aimed at prevention and control of NCDs, as we elaborate below. These initiatives in the new millennium contributed substantially creating the background environment for the UN General Assembly Meeting on NCDs (see above).

G1E. Global NCD Action Plan

This was endorsed by the World Health Assembly in May 2000. Its three foci were: (1) mapping the NCD epidemic and determinants; (2) reducing the level of exposure of individuals and communi-
ties to the major NCD risk factors; and (3) strengthening health system care for people with NCDs (11).

G1F. Global Strategy on Diet, Physical Activity and Health – 2004
After six regional consultations held with Member States and organisations of the UN system, other intergovernmental bodies, representatives of non-government organisations, the private sector and a reference group of independent international experts on diet and physical activity from the different WHO regions, a document on the Global strategy on diet, physical activity and health was promulgated in 2004 (12). The strategy addresses ways of modifying two of the main risk factors for NCDs, namely, diet and physical activity.

The document recommends a multisectoral approach that mobilises the combined energy, resources and expertise of all global stakeholders (12).

This initiative from the WHO was directed at the international community as well as individual governments to sensitisise them to the need for urgent action to enact chronic disease prevention and control programs. The document provided a policy framework for action and outlined a series of objectives and action items for key stakeholder groups at varying levels of the global health system.

It urged WHO Member States to develop national policy frameworks, establish prevention and control programs, share their experiences and build capacity to address chronic diseases. The plan focused on low- and middle-income countries. This action plan was endorsed by all 193 member states during the 61st World Health Assembly, held in May 2008 (13).

G1H. The Doha Declaration
In May 2009, the Western Asia Ministerial Meeting, organised under the auspices of the UNESCO (UN Economic and Social Council), the WHO and the Social Commission for Western Asia (ECWSA), and hosted by the Qatar government, adopted the Doha Declaration on Non-communicable Diseases and Injuries. It also called for a review of international experience in the prevention, control of NCDs and injuries in low- and middle-income countries, including community-based programs, to identify and disseminate successful approaches for intersectoral action (14).

G1I. Framework Convention on Tobacco Control
This treaty was adopted by the World Health Assembly in 2003 and has been ratified by more than 170 countries. The Framework Convention on Tobacco Control (FCTC) encourages the countries to strengthen their tobacco control policies by enacting price regulations, taxation, regulatory, and social measures to reduce demand. The treaty represents a major milestone in the global fight against tobacco and has prompted much international collaboration around tobacco control (15).

Currently, 170 countries are signatories to the WHO FCTC, covering 87% of the world’s population. A top priority of the UN High-level Meeting on Non-Communicable Diseases was to strengthen political resolve for more complete implementation of FCTC and to adopt its protocols with the ambitious goal of a world essentially free of tobacco (prevalence < 5%) (2).

G1J. The MPower Initiative
MPower (WHO, 2008) builds on the WHO-FCTC guidelines with six proven effective policy recommendations. The six recommendations (the first letters of which roughly form the acronym MPower) are:
- monitor tobacco use and prevention policies;
- protect people from tobacco smoke;
- offer help to quit tobacco use;
- warn about the dangers of tobacco;
- enforce bans on tobacco advertising, promotion and sponsorship; and
- raise taxes on tobacco.

According to the WHO report on the global tobacco epidemic 2013 (16), more than 2.3 billion people – one-third of the world’s population – are now protected by at least one of the MPower measures. Nearly one billion people are protected by two or more measures. The report also claims that an additional three billion people are covered by national mass media campaigns (16).

G1K. World Health Assembly resolution on the global strategy to reduce the harmful use of alcohol
In May 2010, the World Health Assembly adopted the global strategy to reduce the harmful use of alcohol in its declaration. The declaration urges the Member States to adopt and implement the global strategy to reduce the harmful use of alcohol as appropriate in order to complement and support public health policies in member states and to mobilise political will and financial resources for that purpose (17).

G2. Group and regional initiatives
G2A. European Parliament declaration
The European Parliament in a declaration (18) on the eve of the UN High-level Meeting on NCDs, called on the EU and its Member States to endorse the following five key commitments and include them in the political statement to be issued at the UN High-level Meeting on NCDs:
- Reduction of preventable NCD mortality by 25% by 2025, as proposed by the WHO.
- Implementation of cost-effective and cost-saving interventions.
- Monitoring of trends in NCD mortality and the common risk factors for NCDs.
- Development of global and national accountability mechanisms for all key stakeholders involved.
- Establishment of a high-level partnership in 2012, to foster the implementation of the recommendations and the organisation in 2014 of High-level Meeting to review the degree to which commitments have been honoured.

G2B. The Parma Declaration on
Environment and Health
The Parma Declaration was adopted by the 53 Member States of the WHO European Region in March 2010 (19). The declaration recognised the burden of NCDs, and in particular the extent that it can be reduced through adequate policies in areas such as urban development, transport, food safety and nutrition, and living and working environments.

G2C. CARICOM Summit Declaration – 2011
Deep concern was raised about the impact of NCDs in the community at the meeting of the Heads of Government of the Caribbean Community (CARICOM) during their 2011 meeting in Port-of-Spain (20). The meeting welcomed the adoption of the Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-Communicable Diseases, held in New York in September 2011, and emphasise the need to strengthen action and partnerships aimed at realising the commitments contained therein.

In this regard, the meeting reaffirmed the commitment to addressing four diseases – diabetes, CVD, chronic respiratory illnesses and cancer; four risk factors – tobacco, diet, physical inactivity and inappropriate alcohol use; and four strategic approaches – risk factor reduction, health system reform, equitable access to effective affordable medications and improving surveillance, and program monitoring and evaluation.

In an earlier summit in 2007, a 14-point Action Plan on Non-Communicable Diseases was adopted by the meeting of the CARICOM during their 2007 September Summit on Non-Communicable Diseases at Port-of-Spain (21).

The declaration documented commitment from the heads of government to give full support for the initiatives and mechanisms aimed at strengthening regional health institutions; immediate pursuance of a legislative agenda for passage of the legal provisions related to the International Framework Convention on Tobacco Control; and development of public education programs on lifestyle management. The declaration also stated that the public revenue derived from tobacco, alcohol or other such products would be employed for preventing NCDs thereby promoting health and supporting the work of the commissions.

Additionally, the declaration called for mandatory re-introduction of physical education in schools, providing incentives and resources to effect this policy and ensuring that the education sectors promote programs aimed at providing healthy school meals and promoting healthy eating (21).

G2D. Commonwealth initiatives
The Commonwealth Heads of States and Governments, which represents one-third of the world’s population, met in Port-of-Spain in November 2009 and issued a statement on Commonwealth action to combat NCDs. The meeting resolved to work towards reducing the incidence of NCDs by fostering multi-sectoral policies and community-based initiatives to discourage tobacco use and unhealthy diets and to promote physical activity (22).

G2E. NHLBI international research initiatives in non-communicable diseases
Funded (US$34 million over 4 years) by the National Heart, Lung and Blood Institute (NHLBI) of the US National Institutes of Health and UnitedHealth Group, 11 collaborating centres of excellence were supported to conduct research into NCDs commencing in 2009. The centres are located in Argentina, Bangladesh, China, Guatemala, India-Bangalore, India-New Delhi, Kenya, Peru, South Africa, Tunisia and along the border of the US and Mexico (23). The success of this venture is yet to be established, and global financial instability is a threat to its future.

G3. Country-specific initiatives
It is reassuring that many countries with a large burden of NCD have recognised the magnitude of the problem, and have responded with programs to combat NCDs. In the following section we summarise NCD prevention initiatives in the five study countries described in our report.

G3A. Brazil
Health care reforms in Brazil began in 1988 as part of a broader sociopolitical movement after nearly 20 years of military rule. The new constitution, which was guided by principles of political decentralisation and community participation, laid the foundation for the Sistema Único de Saúde, or Unified Health System. This marked the beginning of a nationwide shift from tertiary centre-based health care to comprehensive primary health care (24,25).

The Family Health Program, which was initiated in 1994, is the main program relevant to the control of CVD and other chronic diseases. Through it, community health workers identify problems in chronic disease management and medication adherence. They support healthy lifestyle choices through home-based health promotion and education, provide continuously updated population registers and ensure disease surveillance. Finally, they also identify simple acute health problems that can be dealt with in the home (24,25).

The Brazilian Center for Chronic Disease Control (CDC), Brazil’s Ministry of Health (MOH), and the World Bank initiated the VIGISUS (Disease Surveillance and Control Project) which seeks to improve and strengthen the national disease surveillance and control system to reduce mortality and morbidity. This is a systematic process (VIGISUS I,II and III) that will help develop public health infrastructure for NCD prevention in Brazil.

In 2006, the National Health Promotion Policy was published and a comprehensive chronic disease risk factor surveillance system (VIGITEL – Surveillance of Risk and Protective Factors for Chronic Diseases Telephone Survey) was created with technical support from the University of São Paulo School of Public Health and the Brazilian CDC (26).

Strong legislation and a government-led nation-wide decentralised program
that addresses the public health problems typical of low income countries and those undergoing the epidemiological transition (24,25,37). The high rate of economic growth of Brazil in the same period also might have contributed to the effect. Other countries that face the same problems should look into this Brazilian model of primary care for inspiration (38).

G3B. China
The National Centre for Chronic and Non-Communicable Disease Control and Prevention (NCNCD) was established in 2002, under the leadership of the Chinese Centre for Disease Prevention and Control, which is the technical counterpart of the Ministry of Health. The NCNCD is the institution for chronic disease prevention and control at the national level, and is responsible for surveillance and population-based interventions (39).

Data regarding the incidence and prevalence of CVD have been collected from different parts of China (40-42). Following the framework of the WHO STEPs Surveillance system, the first National Risk Factor Surveillance Survey was conducted in August, 2004.

The China Cholesterol Education Program started as a national survey approved by the Ministry of Health of China in 2004, as one of the Top 100 Programs in the Future Decades. It aimed at investigating dyslipidaemia and to publicise therapy aimed at reducing cholesterol levels in China (43).

China signed the WHO FCTC in 2004, signalling a change of attitude of Government toward tobacco control (44). In December 2012, the first tobacco master plan for China, the Tobacco Control Program 2012–15, was initiated by the Chinese government. It includes an ambitious target of reducing the adult smoking rate from 28.1% in 2010, to 25% in 2015, a relative reduction of approximately 10% (45).

Despite these positive developments, we should recognise the China National Tobacco Corporation is the world’s largest single producer of tobacco products, producing 40% of the world’s cigarettes, and that it is protected by the government. There are also no smoking bans in public places except for few locations in Beijing and Shanghai. Tobacco taxes in China are among the world’s lowest.

The National Initiative of Healthy Lifestyle for All program, is a government-initiated program implemented through the China Centre for Disease Control network country-wide. It commenced in 2007 to promote healthy lifestyles among the Chinese population. The relevant health promotion activities are implemented in most Chinese provinces (46). For example, salt reduction is a primary theme for the next 2 years in this program (47).

In addition, several innovative and novel approaches are being evaluated by academic, private and not-for-profit organisations. For example, the NHLBI-funded China Centre of Excellence is evaluating two novel intervention programs through the China Rural Health Initiative. The programs are detailed below (48).
The Healthcare Provider Program is a primary care-based program seeking to enhance the identification and the need for medical management of individuals at high cardiovascular risk. Part of this plan will be the temporary assignment of doctors to the countryside. The government will provide most of the funding, with some small contributions from the public, so that the goal of universal health coverage can be achieved.

The Community Education Program aims to reduce salt consumption in the population. The program is developing strategies that include working with village doctors, store owners and people in the community. The education component of the program is focusing on healthy habits, behavioural change and alternatives, such as the use of salt substitutes (48).


The Healthy Cities Initiative, led by local Governments and collaborating efforts from various other governmental departments, is spreading from major cities to minor cities needs mention. An example is the Healthy Beijing Action Plan (2009–2018). Under this initiative and strengthen and upgrade the public health infrastructure to Indian Public Health Standards (54).

The focus of the NPDCS is health promotion and prevention, strengthening of infrastructure including human resources, early diagnosis and management and integration with the primary health care system through NCD cells at different levels for optimal operational synergies (55). The strategies of NPDCS are aimed at three areas in society: schools; community; and workplace. Rainbow Ribbon clubs – health clubs that increase awareness among children about CVD and its risk factors are established in each school. In workplace and community, activities revolve around conducting medical camps that will screen patients to rule out CVD and its risk factors and for imparting health education.

The main objectives of the Indian NPDCS are:

- Promotion of healthy lifestyle through massive health education and mass media efforts at country level, opportunistic screening of persons above the age of 30 years.
- Establishment of NCD clinics at community health centre and district level, development of trained workforce and strengthening of tertiary level health facilities.
- Screening of over 70 million adult population (30 years and above) for diabetes and hypertension, early diagnosis of NCDs and treatment at early stages.
- To fill the gap in the health delivery system, to train about 32,000 health personnel at various levels to provide opportunistic and targeted screening, diagnosis and management of NCDs (56).

The pilot project was completed successfully (successful in establishing certain systems in CVD control, although we don’t have any outcome measures) in October 2010, which led the government to extend it to more regions in the country. Subsequently, the program was extended to selected districts in major states in India. An outlay of US$2.8 billion was allocated for the period from 2010 to 2012. The new program, which includes cancer, is renamed the National Programme on Prevention and Control of Cancer, Diabetes, CVD and Stroke (NPDCDS) and is currently being implemented in 20,000 sub-centres and 700 community health centres in 100 districts across 15 states (53). Under the program, 8.7 million adults were screened until 2012. Of these, 6.7% were found to have diabetes and 7.7% had hypertension (57). The outcome of those screened and their follow-up is the key issue, for which we have to wait and see.

In April 2013, the Indian Health Ministry announced plans to extend the NCPDS program to all districts in the country from the current 100 districts during the ongoing 12th Five Year Plan (2012–2017) (57). Also, the successful program of providing free generic drugs which was implemented in certain states will be extended to the whole country.

Based on the success of the NRHM, the National Urban Health Mission (NUHM) was initiated on 1 May 2013 (58). This is expected to address the primary health care needs of nearly 40% of the urban population living in slums and other poor areas, who are one of the important primary targets of CVD prevention. The NUHM is expected to cover all cities that have a population of more than 100,000 (59). In the Union Budget of 2013, it was proposed to integrate both NRHM and NUHM into a single initiative – the National Health
Mission – incorporating all the programs envisaged under NRHM and NUHM. India, which is second only to China in global tobacco consumption, is waging a battle against tobacco. The Supreme Court of India ratified an order banning smoking in public places in 2001. India ratified and signed the FCTC in 2003. The National Tobacco Control Program (NTCP) was started as a pilot program in the state of Assam in 2007. Subsequently it was extended in 2007–08 to 18 districts of nine states and in 2008–09, 12 new states covering 24 districts were added to the program. Even though the budget allocation for the NTCP was made in 2007, the cabinet approval for the NTCP was given only in January 2010. Ultimately, the NTCP is expected to cover the entire country.

G3D. Russia
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Russia has one of the world’s highest rates of CVD mortality, as we have discussed. The prevalence of risk factors is also very high and it has not fallen in the past 40 years, especially the prevalence of smoking.

Alcoholism is a problem with a very high impact in Russia. The results of the analysis suggest that 41.1% of all deaths among men and 30.7% of deaths among women from ischaemic heart disease (IHD) in Russia could be attributed to alcohol (60). Even though alcohol-related deaths have come down from 800 per 100,000 men in 1994 to 290 per 100,000 by 2002, this rate is still higher than nearly any other nation (61). The Russian government enacted a new law on regulation of the production and turnover of ethyl alcohol and alcohol-containing products, which was signed by President Putin on July 2005 (62). These measures are not very successful, and the Putin government has come out with tougher measures and a nationwide campaign against alcoholism in 2012. The Russian parliament Duma has banned internet alcohol advertisements, and raised the legal age of drinking from 18 to 21 years (63).

The Russian government has recognised the importance of the problem of CVD and has started the Priority State Project “Zdorovie” (“Health”) in 2006, including various programs to combat the problem of CVD. The State Law on Health Protection in citizens of the Russian Federation, endorsed by the Parliament in 2013, established the priority of NCDs prevention in Russian health care and its realisation through federal and regional state programs on healthy lifestyle and risk factor control with priority given to smoking and alcohol consumption.

The 13-country Global Adult Tobacco Survey (GATS), which monitored adult tobacco use and key tobacco-control indicators, provided the first evidence-based national data on tobacco prevalence and other indicators from Russia. Results from 2009 from the GATS showed that 39.1% of Russians (43.9 million) were currently smoking tobacco, of whom 60.2% were men and 21.7% were women (64). The Ministry of Health’s National Research Centre for Preventive Medicine estimates that 500,000 people die from illnesses related to tobacco each year, 80% of whom die in age below 60 years. About 40% of deaths from coronary heart disease among men are linked to smoking (65).

Russia joined the WHO’s FCTC in 2008, being one of the late signatories. Following this a law came into effect in 2010 that stated that at least 80% of the surface of a cigarette pack must contain information about tobacco harm. The Russian government increased health care funding, sixfold from 2001 to 2011, and programs designed to curb smoking and alcohol and to encourage healthy lifestyles have been launched. Recently, President Putin signed one of the most stringent laws in the world on smoking bans. According to this law, restrictions (e.g., smoking in medical and educational institutions, airports and railway stations), have started from 1 June 2013, A total ban on smoking in public places in Russia will come into force in 2015.

One of the first attempts in primary prevention of CVD in Russia is in the creation of 502 health centres for adult population and 193 health centres for children around the country, which were opened in 2009. People can attend these centres, free of charge. For basic health screening (including smoking status, obesity, blood pressure, blood glucose levels, cholesterol levels, electrocardiogram [ECG]), Almost 5,000 doctors have been trained on healthy lifestyle counselling.

Promoting prevention and wellness has been chosen as one of the key health priorities under the Bilateral Presidential Commission between the presidents of US and Russia, which was announced in July 2009, and chronic disease prevention will be one of the key areas in this cooperation. The mortality trends for the period 2004–2010 show that there is decline in cardiovascular disease mortality (66). Among men and women aged 45–64 years, reductions in mortality from ischaemic heart disease contributed most to the rise in life expectancy; while at ages 65 years and older, reductions in mortality from cerebrovascular disease had the biggest impact. Since 2003 the cardiovascular mortality on the Russian Federation is decreasing, including a 21% decline in 2012 (66).

In spring 2013, the Ministry of Health of the Russian Federation started a large state-level program, called “dispanseri- zation”, which is a comprehensive health check aimed to evaluate non-communicable, chronic diseases and their risk factors in adult population (above 21 years). The program has begun in outpatient clinics throughout all regions of the Russian Federation, and more than 23 million people will be involved.

G3E. South Africa
Cause-of-death statistics indicate that overall mortality from NCDs has hardly changed in the past 10 years in South Africa (67), although reductions have been reported for certain risks, such as smoking (68,69).

The South African national health
and nutrition examination survey (SANHANES) is a national survey that is expected to provide critical information to map the emerging epidemic of NCDs in South Africa. The survey is expected to bridge the gap of information about the current status of NCDs in the country. The first report (SANHANES-1) was released in August 2013 (70).

A national summit on NCDs was convened by the South African Ministry of Health in September 2011. The major outcome of the summit was that South Africa has set targets to radically reduce NCDs through a set of commitments and a strategic plan that addresses prevention, early detection, behavioural change and universal treatment. These targets were incorporated in the South African Declaration on the Prevention and Control of Non-Communicable Diseases, which was issued ahead of the UN Summit on Non-Communicable Diseases (67).

South Africa has several programs aimed at CVD prevention and control. The anti-tobacco campaign in South Africa is one example. In South Africa, the first Tobacco Products Control Act was signed in 1993, which initiated many steps towards effective tobacco control policies. The Tobacco Products Control Amendment Act of 1999, signed by President Nelson Mandela, created one of the most effective tobacco control policies in the world. There were many issues with the law which needed further amendments, which were enacted in 2007 to ensure optimal tobacco control in the country. SA endorsed the FCTC in June 2003 (71).

The impact of the tobacco control policies was dramatic. Among South Africans, 15 years and older, the smoking prevalence decreased from 32% in 1993 to 24% in 2003. The largest reduction in smoking between 1993 and 2003 occurred in men, African and coloured people, as well as in those with limited education and a low income (68). Another study that compared smoking prevalence in 1998 and 2003 found that the daily or occasional smoking prevalence among women remained unchanged at 10%–11%; it decreased among men from 42% in 1998 to 35% in 2003 (69).

The South African Ministry of Health has issued mandatory regulations passed in March 2013, to begin in 2016, which will affect the salt content of processed food (72). This is expected to reduce the mean population intake of salt from the present level of 8–10 g/day to less than 5 g/day by the year 2020. A reduction in salt by 0.85 g/person/day is expected to have significant reductions in CVD deaths and stroke, and to lead to health care cost savings (73).

Recently, the Diabetes Strategy for Africa was launched, which calls upon governments, non-government organisations and industry to implement this integrated approach to reduce the burden of diabetes in Africa (74).

Key elements of the strategy include supporting patients to follow a healthy lifestyle with physical activity, a healthy diet and no smoking. The plans also include the provision of adequate, appropriate and affordable medications and supplies for people with diabetes; earlier detection, optimal quality care of diabetes; and the dissemination of information and education in order to improve self-care (74).

Hypertension is identified as a major CVD risk factor in South Africa (75). South Africa has a national program for the control of hypertension at the primary level – which includes primordial, primary and secondary prevention strategies. The CORIS study was conducted in three towns in the South-Western Cape in white communities (76). This study developed a model of active community-based interventions set on the principles mentioned above. This showed that the intervention towns managed to achieve better blood pressure control than the non-intervention towns after 4 years.

A national NCD plan is being developed by the government of South Africa, and a pilot project has been set up to initiate integrated care in the facilities of three districts (67).

G4. Combating NCDs: where are we? Despite the above mentioned numerous initiatives and efforts at reducing NCDs there are several challenges. Broadly, the challenges stem from: (a) perceptions; (b) inadequate implementation of program plans; and (c) the pushes and pulls of multiple stakeholders and their vested interests.

G4A. Perceptions
The principal focus of health programs in developing countries remains infectious diseases, such as HIV/AIDS and tuberculosis, and under-nutrition, while NCDs are commonly viewed as something that can wait (77,78) until the infectious diseases have been “controlled”. There are arguments that shifting the focus to NCDs; for example, by having a universal free health service access, will channel resources more towards the rich than to the poor (78).

There is ample evidence to show that risk factors of CVD are prevalent in low socioeconomic groups at least to the same level as high socioeconomic groups, if not higher (79). For example, the studies done in the post-liberalisation era in India indicate that while once CVD risk factors were highly prevalent among the affluent, now they are principally present among the less well off as well (79). The Bill and Melinda Gates Foundation do not include chronic disease in their remit. Even the 2010 UN summit on the 2015 Millennium Development Goals that included the announcement of major new commitments for initiatives against poverty, hunger and disease, contained no plans to target NCDs (80).

There are no initiatives to combat CVD comparable to the Global Fund to fight AIDS, Tuberculosis and Malaria.

G4B. Inadequate implementation of program plans
While many programs for NCD and CVD control have begun virtually worldwide, implementation remains weak and limited. For example, the first wave of the GATS after the FCTC (16 countries, three billion people) has shown persistent high rates of smoking in men, early
initiation of smoking in women, and low quit ratios (81). Eight years after the adoption of FCTC by the world community in 2003, only 10% of global population have comprehensive national bans on tobacco advertising, promotion and sponsorship. Just some 15% of the global population have a national comprehensive smoking cessation service as of 2013 (16). Only 14% of the global population meet the best practice for pictorial warnings in local languages that cover at least half of the front and back of cigarette packs (16).

China’s endorsement of the FCTC in 2005 has made little difference in China’s tobacco control, and the country lags behind many of the targets prescribed by the FCTC (82,83). Although India signed the FCTC in September 2003 and ratified it in February 2004, much remains to be done. Legislation in 1975 that made health warnings on cigarettes mandatory was largely ineffective (84).

In 2003, the Indian Government passed the Cigarettes and Other Tobacco Products Act. The bill offered comprehensive legislation for all tobacco products, developed after expert consultants identified tobacco as a “demerit commodity” in India (84). Although the bill called for graphic warnings on cigarette packets and other tobacco products, these were not implemented until 2009 after many delays, and finally the high court had to achieve implementation (84).

In India, 165 million adults use smokeless tobacco. As per the WHO report on the global tobacco epidemic, 2011, none of the South East Asian region countries, including India, currently meets the best-practice level for health warnings on smokeless tobacco products (85).

There are problems regarding awareness about existing anti-tobacco legislation among the general public in India (86). Awareness does not translate into effective implementation due lack of administrative support, lack of interest among the stakeholders, fear of public opposition, and lack of financial and human resources (87). Lack of clarity in the program protocols, relatively few frontline health workers, and few physicians working in or interested in public health mean that progress is slow.

The best way to implement NCD control programs, as discussed elsewhere, is through the primary health care system. But as we know in India, the primary health care system is already over-burdened with all the national programs channelled through it. Unless the existing system is strengthened NCD programs are also unlikely to succeed.

G4C. Multiple stakeholders and their vested interests
The implementation of NCD prevention program can be easily impeded by the presence of multiple stakeholders and their vested interests. NCD prevention programs will always require coordination between different ministries and department (88). This can lead to conflicts and that can affect the smooth functioning of the program. For example, there is scepticism about the implementation of the ambitious Chinese Tobacco Control Program (2012–15), which aims to reduce smoking prevalence by 10% in 3 years. One of the seven governmental agencies implementing the program is the State Tobacco Monopoly Administration, ironically the aim of which is to strengthen and improve the tobacco industry (89).

There are rays of hope, but we have a long way to travel on the journey of NCD and CVD control. With stronger political commitment it is possible to envision a global future where NCDs are reduced so that personal, national and global tragedies that today are attributable to them lose their force.
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CONCLUSIONS

In the US, since the 1960s, owing to the public awareness programs leading to individual behaviour change, together with new therapeutic interventions and procedures, CVD mortality dropped by more than 55%. Countries facing the challenge of an emerging epidemic of CVD might do as well in half the time because of current insights and therapies. Now, we have better drugs that are easier to take (once a day rather than more frequently), tobacco policies that are now widely accepted, consensus-driven dietary recommendations, and a recognition of the importance of physical exercise and the social origins of the CVD risk factors. There is also an understanding of the role of civil society and prudent incorporation of invasive medical and surgical procedures for those at grave risk where society can afford these.

This report poses a dramatic challenge to the public health community, to governments and private enterprise. It also challenges citizens in virtually every country. It suggests that without concerted, ongoing interventions to prevent the precursors and reverse the negative effects of CVD in developing countries, a global health crisis in the current workforces (and later among the elderly) of those countries will occur – and sooner, rather than later. It is apparent in Russia and several other former Soviet republics, and is emerging in China, India and Brazil. This crisis hits not only individuals and their families but the economies of nations, as skilled workers die or become disabled in the prime of life, women are widowed and older people require expensive medical interventions and social support for disability related to CVD.

Combating CVD requires action on a wide range of fronts. What follows is a statement of how we propose to move forward beyond this report. This will necessarily involve research, trial interventions to assess alternative prevention and treatment regimes, consultations with governments, professionals and private industry, macroeconomic and microeconomic initiatives, and powerful advocacy of greater clarity to change individual, social, legislative and commercial behaviour to make affluence less toxic in the developing world.

H1. Putting CVD in the developing world on the international health and development agenda

We, those who are concerned about these issues, and those responsible, need to invest additional effort to increase recognition of CVD as an epidemic, including advocating for its further inclusion in the strategic priorities of international health, economic and aid agencies. To this end, we should continue to present our findings at international meetings, and to participate in global development and health initiatives where possible. CVD and other NCDs should be given top priority among focal diseases for attention and we should maintain the momentum gained out of the UN general assembly declaration on NCDs.

H2. Deeper documentation of the prevalence and costs of CVD

Our study has examined CVD in five developing countries, using available data (which are albeit sometimes hard to obtain, especially in the case of economic data). In order to put a persuasive case to governments concerning the need to act in relation to CVD, it is important that assessments that are more detailed be made of CVD prevalence and costs. It is a good sign that such data are being generated of late from many lower middle-income countries. Data generation will require work in the countries by people committed to the task of surveillance, data extraction and ultimately building a robust health management information system.

H3. Developing partnerships at the macroeconomic level with national governments in key developing countries

We can use these data as well as those provided in this report as entry points for advocacy in several developing countries. This work should aim first at putting CVD on those countries’ health and development agendas, and then on establishing working partnerships with representatives in the countries to pursue policy recommendations in relation to CVD management and prevention. This will include, where relevant, health system and health delivery initiatives, and work with government agencies in relation to taxes on tobacco products, subsidies for agricultural products, food labelling, guidelines for town planning and transportation systems etc. We propose that this work may be initiated in four countries: Brazil, China, India and South Africa. Excellent work is occurring in this field through the efforts of the WHO and other groups that forms a basis for further action.

H4. “Train the trainer” initiatives in health education

Low- and middle-income countries vary in the extent to which they have trained
health personnel capable of providing close-to-client primary care services. Often, educators will have trained these personnel primarily in the treatment of communicable diseases and in basic public health requirements. They may require additional training in the management of CVD. Specialist doctors and nurses will provide this training by donating their time to work with professionals on the ground in the countries concerned. Training will also include the development of treatment protocols, complementing the WHO initiatives such as the WHO CVD-Risk Management Package for low- and medium-resource settings, but these have to be updated periodically as data is pouring in daily.

H5. Undertaking trial treatment and prevention interventions
There are many possible points of entry for prevention and treatment of CVD and its precursor conditions. We propose several complementary strategies (identifying an entry point, task-shifting and task-sharing and use of generic medications). First, focusing on hypertension, we will seek cooperatively to develop treatment interventions in three or four countries. In India, we could use existing primary health centres and the multi-purpose health care workers employed under the National Health Mission. In South Africa, the establishment or reactivation of primary care facilities for the expanded programs of treatment of HIV/AIDS with antiretroviral drugs may provide a good opportunity for also treating CVD risk factors. With help from existing governmental agencies, we expect good progress. In Brazil, with a government committed to expanding primary care, now may be a good time to investigate what is possible for widespread CVD treatment in its many communities.

Universal health coverage may be an important mechanism which can lead to the sustainable development goals, as we envisage. In all of these countries, it will be advisable to seek out industries (e.g., the pharmaceutical industry in India, through generic drugs) that might be interested in supporting these approaches. Philanthropic organisations such as the Melinda and Gates Foundation that is currently supporting the HIV/AIDS program can be approached to extend their reach to include NCDs also. This will require strong, evidence-based advocacy, not only in relation to stressing how large the problems are, but also pointing to feasible, scalable interventions that are likely to be effective, affordable and sustainable.

H6. Longer-term research and interventions
A research base is essential for progress to be made in relation to the effectiveness of interventions and changes to the health systems that a CVD control program would demand. To demonstrate to governments the benefits of controlling CVD and its precursor conditions, ongoing research and evaluation in a range of countries are required. This involves working with existing bodies, such as the Center for Chronic Disease Control and the Public Health Foundation in India, and developing a research capacity in countries where this is lacking. The intention would be twofold: to confirm that the preventive interventions in which they have invested are producing promised outcomes, and second, to learn from the experience, improving the quality and efficiency of local interventions, both preventive and therapeutic, in that country and elsewhere.