Reducing Cardiovascular Disease Globally
The World Heart Federation's Roadmaps

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Mankind has witnessed the rise and subsequent fall of various epidemics over the last few centuries. Until the last century, most epidemics were a result of infections, undernutrition, poverty, or conflicts. With improvements in the economies of most countries in the last 100 years, systematic vaccination programs, wider use of antibiotics, and improved nutrition from advances in the production and distribution of food, and micronutrient supplementation, deaths from many of these diseases have been substantially reduced globally. Although segments of populations in many countries (especially in low-income countries) still experience these conditions, premature deaths from infections and undernutrition have been substantially reduced in high-income countries and many middle-income countries [1]. However, with the aging of the population, and improved economic growth, diseases of undernutrition have been replaced by diseases of overnutrition in many countries, with increases in obesity, hypertension, and related metabolic diseases such as cardiovascular disease (CVD), diabetes, and cancers—collectively termed noncommunicable disease [2]. These have been compounded by the widespread use of tobacco. The epidemics related to infectious diseases and undernutrition in high-income countries were overcome by both technologic (e.g., vaccination, antibiotics, improved food production and food fortification, improved health care) and social interventions (e.g., widespread vaccination, quarantines). Similarly, the conquest of the noncommunicable disease, especially CVD will depend on a range of different strategies. Over the last 4 or 5 decades, substantial evidence has accumulated from different types of research that CVD can be largely avoided by using technologies (e.g., drugs to control hypertension or to prevent subsequent CVD events in those with known heart disease or strokes) [3,4], as well as social interventions (e.g., policies to reduce tobacco use) [5].

Scientific bodies have reviewed the evidence and developed guidelines for the prevention or treatment of specific CVD. However, despite the extensive research in CVD, only about one-third of the recommendations in guidelines are based on the highest quality of evidence, with the majority of recommendations being based on best opinion (e.g., the Class II evidence) and weaker data [6]. Therefore, guidelines need to be periodically revised to incorporate new evidence that may at times refute existing recommendations. Furthermore, guidelines by themselves rarely change clinical or public health practices, even when they are based on high-quality evidence. New proven strategies that improve health are often slow in being adopted, and rescinding policies or treatments that have been proven to be useless or harmful has been even more difficult.

What is needed are systems to incorporate new evidence (in favor of wider use of prevention or treatment strategies or to withdraw useless interventions) and to monitor progress in their implementation and relate their use to the changes in rates of CVD in a community or country. Efforts to document and understand the impact of barriers to an intervention, the readiness of a community (physicians, policy makers, or the public) to accept them, and the availability and affordability of such interventions are required. In parallel, systems to document the "lay of the land" (situation analysis) before strategies are implemented and then monitor change are key. If adoption of beneficial therapies (or deimplementation of unproven strategies) are insufficient, we need to understand the reasons for failure and re-engineer implementation plans. Such an approach is iterative. Some theoretically appealing strategies initially fail to be adopted but understanding the reasons for failure facilitates developing more effective implementation strategies. Even enhancing the use of clearly proven simple secondary prevention strategies (e.g., smoking cessation, use of aspirin, beta-blockers, angiotensin-converting enzyme inhibitors and statins in those who have vascular disease) has been unexpectedly challenging. At present less than one-half of patients with known vascular disease in high-income countries are on optimal lifestyles and appropriate drugs, but this is only less than 10% in low-income countries (with the rates in middle-income countries, being in between) [7,8]. So why is it that even something as clear-cut and cost-effective as secondary prevention is so poorly implemented worldwide, including in high-income countries where they are widely available and affordable? Is it because physicians are uninformed or are patients reluctant to accept prevention strategies? Or in the case of middle- and low-income countries, are these interventions not available? Or if available, are they affordable? Or is it that there are too few health workers to implement them? Or is it too difficult and expensive to access the necessary health workers? The reasons and their relative importance in the evidence-implementation gap may vary by setting (rich or poor country, and urban or rural settings) or by population (with or without insurance or education), their attitudes (related to health and prevention of subsequent events), especially when individuals may be asymptomatic some months or years after a CVD event.

TABLE 1. Major CVD events in the PURE study

	Total People With Condition	Major CVD During Follow-Up (n = 3,488, 2.23%)
Known CVD	7,743 (5.1)	673 (19.3)
Hypertension, history or BP >140/>90 mm Hg	62,034 (40.7)	2,317 (66.4)
Current smoker	31,397 (20.6)	1,021 (29.4)
Known CVD, hypertension, or smoking history	84,078 (55.0)	2,822 (80.9)
Diabetes, history or FPG >7 mmol/l	16,071 (10.5)	905 (26.0)
Known CVD, hypertension, diabetes, or smoking history	88,326 (57.9)	2,929 (84.0)

Values are n (%). Major CVD events include CV death, myocardial infarction, stroke, or heart failure.
The PURE cohort comprised 152,000 individuals, ages 35 to 69 years, from 17 countries.
BP, blood pressure; CVD, cardiovascular disease; FPG, fasting plasma glucose; PURE, (Prospective Urban Rural Epidemiology).
Source: Unpublished data, used with permission, from the PURE study.

Furthermore, the reasons for lack of implementation may vary over time in the same population, so the approach to implementation of the same intervention will have to be customized to the economic circumstances, cultural attitudes, and health systems of each country.

So, how do we go about this complex task where the evidence is overwhelmingly clear but appears to be surprisingly difficult to implement? First, it is important to focus on a few interventions that have been clearly proven to reduce CVD and are supported by the highest quality of evidence. Second, to have a measurable impact on a population, these interventions should be feasible in different settings. Third, they need to be affordable (i.e., cost-effective). If all of these criteria are met and the

TABLE 2. Theoretical benefits from key interventions in specific conditions

	Interventions	Potential Relative Risk Reduction CVD Events
1) Secondary prevention	Tobacco cessation, aspirin, beta-blockers, ACE inhibitors and statins	90% [3,4]
2) Hypertension	3 half-dose BP lowering agents reducing SBP by 15 mm Hg	45% [4]
	Statins reducing LDL by 1 mmol	30%
	Combined effects of BP lowering and lipid lowering	~60%
3) Smokers	Smoking cessation	50%
	Potential impact of full implementation of interventions 1 + 2 + 3 in a population	65% to 70%*

ACE, angiotensin-converting enzyme; LDL, low-density lipoprotein; SBP, systolic blood pressure; other abbreviations as in Table 1.
*Even partial success in implementing these strategies would be expected to reduce the risk of future CVD events by 25% to 30%.

interventions are widely implemented, they will likely have a substantial impact in reducing CVD and deaths, thereby benefitting some millions of individuals.

Table 1 (based on unpublished data from the PURE [Prospective Urban Rural Epidemiology] study) shows that 20% of the CVD events that occur in a population come from the 5% of the adult population who are known to have had coronary artery disease or a stroke, that 66% of the events occur in the 40% with hypertension (self-reported or those with blood pressure [BP] >140/90 mm Hg), and that 30% of the events are derived from the 20% who are smokers. Collectively >80% of the CVD events occur from these 3 easily identified subgroups who constitute 55% of the population. Reducing the burden of CVD by targeting these 3 easily identified subgroups of a population is relatively efficient and if secondary prevention, hypertension control, and tobacco avoidance increases by one-third or more, a 25% reduction in CVD can be reasonably expected (Table 2).

Given that the evidence for secondary prevention measures, lowering BP in those with hypertension and tobacco is overwhelmingly clear, the World Heart Federation has prioritized these 3 strategies as the principal and cost-efficient means of reducing CVD globally. In order to facilitate this, the World Heart Federation has created 3 global implementation strategies (or Roadmaps) that are described in the accompanying articles in this issue of *Global Heart*. These global Roadmaps [9–11] describe general principles that need to be adapted to specific contexts. Over the next year or 2, these global Roadmaps will be the basis of developing region- (or country-) specific roadmaps involving an alliance of cardiologists, government organizations, regional health organizations, industry, advocacy and patient groups, among others. A range of local expertise is needed—which includes knowledge of cardiology, prevention, health promotion, health systems, economics, governmental priorities, and cultural and social contexts—to develop and effectively implement country-specific roadmaps. Systems to monitor progress in the processes of implementation (rates of use of proven drugs, percentage of hypertensives with BP controlled, and tobacco policies and rates of tobacco use) as well as their impact on CVD and other outcomes will be essential. Such efforts can be part of national or regional "health observatories" that provide the initial "baseline" information and the necessary feedback by periodically assessing whether the implementation plans are effective. By documenting and publishing such information, countries can learn from each other's successes in diverse settings, and also mitigate failures.

We are at a moment in history when many synergistic forces have converged. The UN political declaration has emphasized the global need for action on CVD and other noncommunicable disease [12]. The research community has developed a body of relevant evidence. Many interventions proposed for CVD control are inexpensive and they should be made widely available. The Framework

Convention for Tobacco Control [13] has laid the foundations for global tobacco control. Proven and cost-effective approaches to reduce BP and for secondary prevention are available and inexpensive. Therefore, a strategy that is focused on tobacco and hypertension control and improved secondary prevention should have a substantial impact in reducing CVD globally. The road ahead will have numerous obstacles, but global, regional, and country-specific roadmaps for implementation will be helpful. We hope that the World Heart Federation's initial 3 Roadmaps will aid in reducing the CVD burden globally.

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