OPINION

# Preventing CVD in resource-poor areas: perspectives from the 'real-world'

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**Abstract** | An evolving epidemic of cardiovascular disease (CVD) is having a profound effect on the health of vulnerable populations in low-to-middle income countries with limited resources. Despite some encouraging signs (particularly initiatives from the WHO), global and regional apathy towards noncommunicable forms of CVD adds to the complexity of issues to consider when establishing cost-effective prevention programs. We present our perspective on overcoming the myriad of barriers to providing cost-effective measures for CVD prevention in a resource-poor environment through the 'prism' of our experiences in establishing the Heart of Soweto Study in South Africa.

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## Introduction

As the global epidemic of cardiovascular disease (CVD), which encompasses a range of conditions from acute coronary syndrome, ischemic and hemorrhagic forms of stroke, valvular disease and chronic heart failure (CHF), continues to evolve—in 2004 it accounted for 21.9% of deaths worldwide[1]—our ability to respond effectively is constantly challenged. In high-income countries, CVD has already left an indelible mark: health care systems are overburdened by increasingly prevalent forms of chronic heart disease that result in both premature mortality and costly hospital admissions.[2] This epidemic has probably stabilized in these countries,[3] and modern-day primary and secondary prevention strategies are postponing the onset of CVD and improving survival rates.[4] However, it is sobering to consider that much of the global burden of CVD (80%) is now carried by low and middle-income countries (LMIC).[1] Figure 1 shows how age-standardized death rates in 'developing' regions of the world rival those seen in the 'developed' world.[5] Unfortunately, many of these regions are still grappling with poverty-related and infectious diseases and are not geared to respond to this growing threat, particularly when faced with a constant stream of migrants to urban centers.[6] In response, the WHO has developed an action plan that advocates three key strategies for limiting the impact of noncommunicable disease (including its major component, CVD) in LMIC: first, mapping the emergence and consequences of an evolving epidemic; second, reducing exposure to common risk factors (primary prevention); third, strengthening health care resources to support those already affected (incorporating secondary prevention).[7]

Within the context of the WHO action plan, we outline in this paper what we believe are the most salient and practical developments and issues for establishing cost-effective prevention of CVD (both primary and secondary) in a resource-poor environment. Our perspectives are very much influenced by our experiences with the Heart of Soweto Study in South Africa,[8] which is a broad program of clinical research and health service development comprising community-based screening for cardiovascular risk factors[9], an advanced clinical registry of tertiary cases of CVD,[10] secondary prevention programs[11] and an extension into primary care clinics. The program is also based on the fundamental premise that any response to the current and future threat of CVD in LMIC, particularly from a preventive perspective, should assiduously avoid any misguided attempts to transplant 'developed' world solutions without careful consideration and local adaptation.[12] For example, although many populations around the world are affected by lipid disorders, this is not a major problem as yet in urban African communities. As such, the application of a 'polypill' approach (see below) including lipid-lowering therapy might well prove to be ineffective and perhaps even harmful. Similarly, a predominance of relatively young black African women with CHF, caused by multiple disease pathways (including a range of valvular disorders), renders the results of clinical trials derived from older, more male-dominated cohorts with ischemic forms of CHF as useful but not definitive without appropriate investigation and careful application.[11]

## Emergence of CVD in LMIC

'Epidemiologic transition'—the social, environmental and economic changes that provide improved nutrition and sanitation, accompanied by a shift in disease patterns—is a major driver of the rising burden of CVD in LMIC.[13] For example, although HIV/AIDS is the leading cause of death in sub-Saharan Africa, CVD, predominantly stroke,[1] is the most common cause of death among young adults aged 30 years or older.[14] Current estimates indicate that the annual age-adjusted CVD mortality rate among males aged 35–64 years in LMIC is double that seen in a high-income country and almost triple for women.[15]

One of the most crippling features of expanded pathways to CVD (that is, beyond infection and now encompassing hypertension and atherosclerosis) in LMIC is, therefore, its effect on young adults who often represent the most productive members (and relied on as 'breadwinners') of the community. It is difficult to estimate the monetary burden of CVD in respect to health care resources and loss of productivity in LMIC, but it is clear that the amount of internal and external funding is inadequate, reflecting a widespread apathy in tackling noncommunicable diseases. For example, it has been estimated that sub-Saharan Africa spent only 2–3% of the amount that high-income countries spent on health care (an average of US$45 per capita in 2004),[7] and that HIV/AIDS has attracted $US1029.10 per related death, compared with $3.21 per

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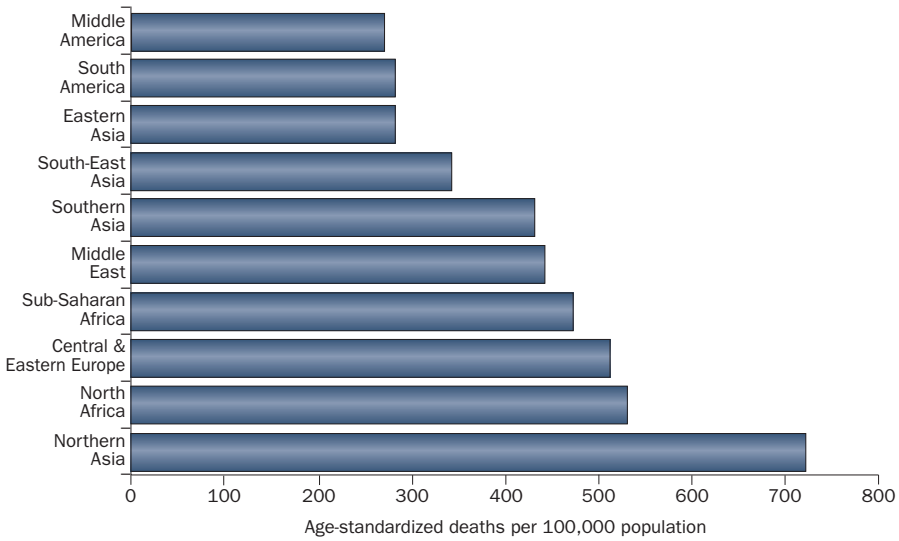


**Figure 1** | Global impact of cardiovascular disease and diabetes: age standardized mortality per 100,000 population (adapted from Abegunde *et al.* 2007).[5]

noncommunicable disease-related death, in global health funding.[16]

## CVD prevention in LMIC

When considering how best to tackle CVD prevention without the 'luxury' of well-resourced research and health care systems, there are a number of specific issues that require careful consideration. For example, although targets for secondary prevention (that is, those with established CVD) are easier to identify, there are several issues relating to both primary and secondary prevention in LMIC that remain unresolved. At the fundamental level, there is a general lack of specific data relating to the cardiovascular risk factor profile, let alone the burden, spectrum and trajectory of established CVD in many communities in epidemiologic transition.[7] Consistent with the recommendations of the Committee on Research, Development and Institutional Strengthening for Control of Cardiovascular Diseases in Developing Countries,[17] therefore, prevention of CVD requires a commitment to community surveillance programs and collation of mortality and morbidity data wherever possible.

There are two broad approaches to CVD prevention that require careful consideration. The first is a population-based strategy for primary prevention that aims to reduce the broad burden of risk and established disease within the whole community. This broad, nonspecific approach requires public promotion and/or legislation changes; therefore, government support at a number of levels is often required. The Disease Control Priorities Project (DCP2) in developing countries[18] advocated such a strategy, focusing on reduced salt consumption to achieve a reduction in blood pressure, and smoking as a risk factor for coronary artery disease, stroke and CHF in sub-Saharan Africa. The INTERSALT study involved a combination of legislation, industry participation and a mass media component, and was found to have a cost-effectiveness ratio of about $48–60 per disability-adjusted life year (DALY) saved. Similarly, the cost-effectiveness of various smoking cessation strategies was estimated to range from $2–26 per DALY to $42–570 per DALY saved.[19]

At the other end of the spectrum, targeting high-risk individuals offers the greatest benefits to vulnerable sections of the population in whom the risk of CVD is greatest.[20] Such an approach is predicated on cheap and accurate risk profiling tools applied through comprehensive community surveillance programs. As cardiovascular risk factors tend to occur in clusters and may have a multiplicative effect on individual risk, an absolute risk approach to CVD prevention and treatment has been advocated.[21] As indicated earlier, whether specific algorithms are accurate within a range of ethnic and culturally diverse populations is still open to debate. Certainly, an absolute cardiovascular risk approach involving a degree of advanced profiling has been modeled in the treatment of hypertension in South Africa and found to be cost-effective.[22] In resource-poor environments, the more-fundamental approaches to cardiovascular risk profiling developed by the WHO,[1] and that advocated by Gaziano,[23] might prove to be as useful.

The same conundrum of applying a population versus individualized response to CVD applies to its active treatment. A multidrug regimen to address the most common risk factors has been proposed to be both cost-effective and reduce the occurrence of CVD by half in high-risk individuals. This 'polypill' approach comprises a statin (lipid-lowering), aspirin (antiplatelet), a β-blocker (antihypertensive), an angiotensin-converting enzyme inhibitor (ACEI), a thiazide and folic acid.[24] Unfortunately, although the notion of 'polypill' might improve adherence rates, the most effective combination of its constituents remains debatable and unsubstantiated by clinical trials. The results of the Indian Polycap Study (TIPS), reported at the 2009 meeting of the ACC, certainly represent a step in the right direction, having proven the overall safety of a broad polypill approach without achieving projected targets of risk reduction. Moreover, the cost-dynamics of applying the polypill undoubtedly differ from region to region. A number of studies have suggested favorable cost-dynamics for the polypill across a range of LMIC.[25] However, the essential costs of supporting health professionals (for example, community nurses), infrastructure (for example, blood pressure monitors and weigh scales) and pathology tests are frequently ignored.

## Practical lessons from Soweto

Given the complexities and challenges of applying optimal CVD prevention measures in a resource-poor environment, it is essential to develop a clearly articulated program that can achieve key targets in a sustainable manner.[12] We believe that our experiences

in developing the Heart of Soweto Study program have derived many salient lessons worthy of consideration.

First, it is important to establish 'healthy' collaborations. In a resource-poor environment with untapped potential, a common imperative is a collaboration with a stronger research/clinical group that provides instant access to much needed capacity and funding. This usually means an international research group with a substantial reputation and track record in the field. Unfortunately, the potential for a destructive rather than positive collaboration, favoring the larger research group, is high. The temptation for those working in high profile institutions to feel superior to, and more experienced than, clinicians and researchers in LMIC is often too great to ignore. However, without a truly equal partnership that recognizes the skill-sets and contributions of both sides of the collaboration there is likely to be a high level of dissatisfaction and subsequent dysfunction.

Second, achievable goals should be set. One of the main dangers when operating within a challenged environment with clearly identifiable needs is to immediately jump to the final solution—in our case this was the creation of 'Framingham in Africa'. However, it has taken time (3–4 years) to develop a comprehensive and sustainable program of tertiary-based CVD surveillance that has the capacity (in the next 3–4 years) to extend to the primary care setting, with a greater focus on primary prevention and specific CVD management programs aimed at secondary prevention. Plans for a population-based screening program are yet to reach fruition. A long-term plan with clearly achievable goals is obviously worthwhile, particularly as success in small steps is much better than grand failures on a larger scale.

Third, think big and assume nothing! Having identified the dangers of jumping too far ahead and trying to achieve the impossible, it is worth considering the (converse) danger of thinking too conservatively. Indeed, giving away invaluable research data and/or failing to develop a truly worthwhile health care program is often underpinned by false assumptions that it is either all too hard or has all been done before. Despite initial reservations about the usefulness of the Heart of Soweto Clinical Registry, we have subsequently realized the potential value of developing a meaningful system for classifying a complexity of CVD not seen in high-income countries.

Fourth, funds should be spent carefully. Unfortunately, the level of philanthropic and global funding to support public health and clinical research into noncommunicable disease states, such as atherosclerosis and CVD arising from metabolic disorders, smoking and hypertension in LMIC, is clearly suboptimal. Attracting funding not only requires careful financial management but a more 'entrepreneurial' approach to seeking funds, for example, through international companies that are required to reinvest a portion of profits into the local environment. The 'proof-of-concept' inherent in successful pilot programs becomes especially important in this context when competing for large-scale funding.

Fifth, it is important to invest in the right people. Although funding is crucial for any effort, it is worthless without the right people to support a research or health care program. The Heart of Soweto Study currently supports a number of key individuals from a range of health disciplines. In each case, there is a focus on 'investment' and personal growth to enable us to (hopefully) tackle the next phase of the overall research program and related health care services. For example, we quickly identified the need to attract experienced cardiovascular nurses with the clinical expertise to capture complex cardiovascular data, and who were prepared to learn new skills and knowledge in respect to clinical and public health research.

Sixth, be prepared to fail! One of the most important features of operating within a resource-poor and challenging environment is being prepared to experiment and fail to find a solution that is appropriate for that environment. In the early phases of the Heart of Soweto Study, for example, we failed to introduce a system of hand-held devices to capture clinical data electronically within an inherently chaotic environment. However, the subsequent system of paper capture via a semi-automated approach to data entry (following clinical verification) has proved to be extremely satisfactory.

Seventh, do not compromise on quality. In a resource-poor environment, potential excuses for poor-quality research and health care relative to the rest of the world may be many and varied and often seem perfectly legitimate. However, if you have set clear and achievable goals, attracted appropriate funding and invested in the right people and resources, there should be no excuse for accepting poor-quality outcomes.

Finally, promote teamwork. In the initial phases of a new health care program, there will always be a need for leaders who develop the collaborations, set clear objectives, attract funding and invest in key personnel through supervision and mentoring. In the longer term it is essential that a team approach emerges, where all members of the team are encouraged and given the opportunity to address all features of the program in an open and constructive manner. This must include patients and representatives of the community who are affected by the research or new health care program.

Ultimately, we would urge those considering a similar program in a resource-poor low-to-middle income environment to consider the following advice: understand the problem thoroughly before trying to intervene, and consider more basic options (that is, cheap and reliable assessment of the major risk factors) before more costly and sophisticated options (for example, advanced biomarkers); maximize the personnel and resources available to you before trying to develop something completely new; adapt any surveillance or interventional models to the local health care and community environment; evaluate any outcomes from a local perspective as a matter of priority over their national or international implications.

## Conclusions

The incidence of CVD is increasing in LMIC, with profound effects on the health of vulnerable populations, particularly young adults of working age. Some positive steps have been taken to address and tackle the problem, including WHO initiatives[7] and salient advice[12] for disease prevention and control. However, inadequate funding for programs that target noncommunicable forms of CVD hinders efforts to establish cost-effective prevention programs. Our

perspective on overcoming the many obstacles in a resource-poor environment is, therefore, based on a 'self-sufficient' approach (that is, building from within the ranks of available personnel rather than importing expertise that will leave just as readily as it arrives) to capacity development at the clinical service and research level.

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