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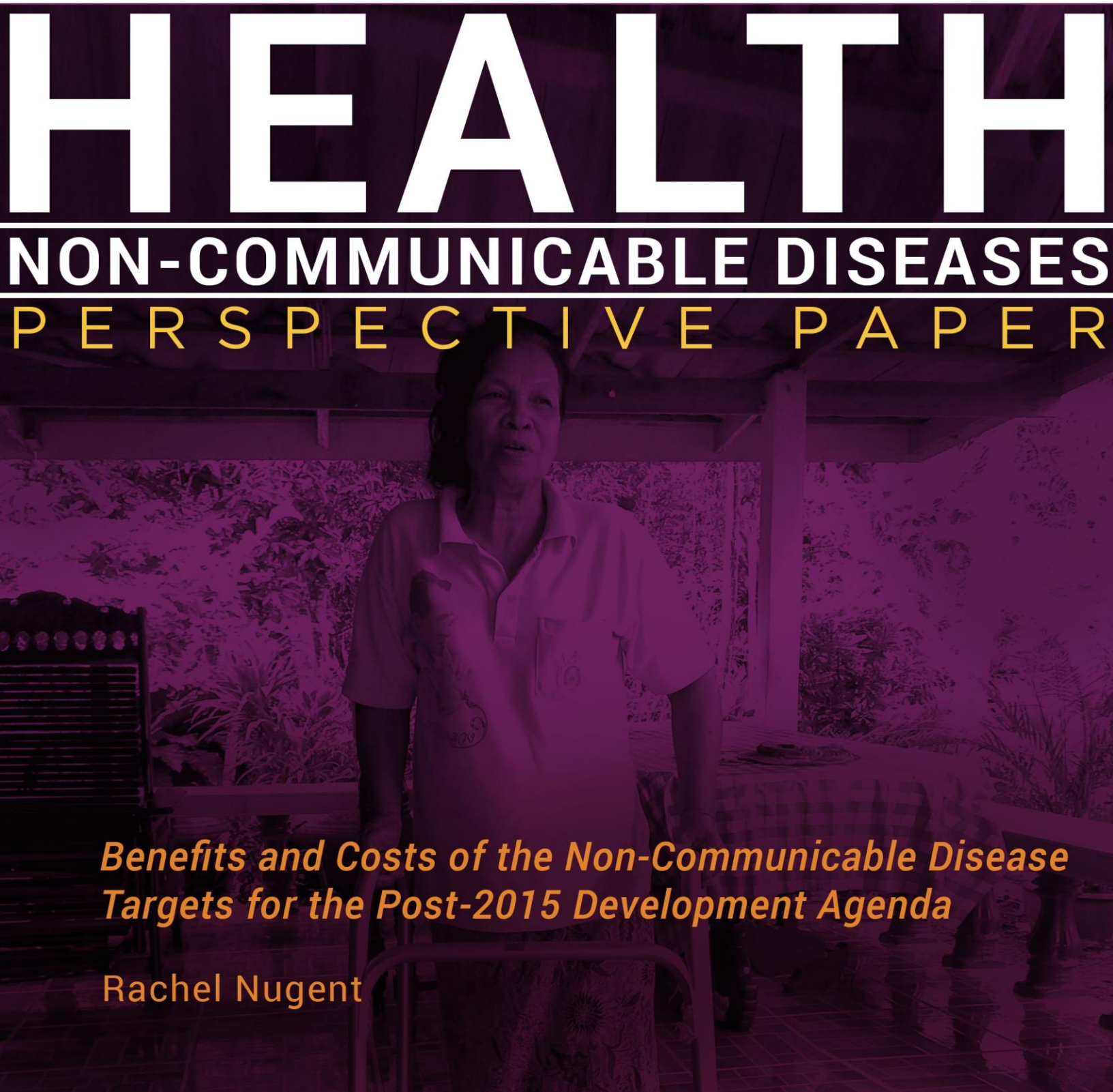
# HEALTH

## NON-COMMUNICABLE DISEASES

PERSPECTIVE PAPER



***Benefits and Costs of the Non-Communicable Disease Targets for the Post-2015 Development Agenda***

Rachel Nugent

POST-2015 CONSENSUS

# Benefits and Costs of the Non-Communicable Disease Targets for the Post-2015 Development Agenda

## Post-2015 Consensus

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## Summary

The post-2015 target of reducing premature deaths from non-communicable diseases (NCDs) by one-third by 2030 is ambitious, but can come close to being reached with increased coverage – especially in low-and middle-income countries (LMICs) -- of a handful of cost-effective interventions. We analyze the benefits and costs of four prevention and treatment interventions that will avert 4.25 million premature deaths from NCDs in 2030, equivalent to a 25% reduction in projected NCD mortality. The average benefit-cost ratio is 8:1 at $1,000 per DALY at a global cost of $8 billion per year. The interventions are: raise the price of tobacco products by 125% through taxation to reduce tobacco use; provide aspirin to 75% of those experiencing an acute myocardial infarction; reduce salt/sodium intake by 30 percent through voluntary measures; and provide preventive drug therapy to 70% of those at high risk of heart disease. The intervention benefits and costs and benefit per dollar are shown in Table 1.

These interventions are consistently demonstrated to be cost-effective in HIC and LMIC settings,[1-4] and are standard in high-income countries (HICs), although not as widely available as they should be. In our analysis, we assume it is feasible to substantially increase coverage of each intervention gradually over 15 years, consistent with the politically agreed NCD targets and other analyses.[1,4,5]

*Table 1. Summary of Intervention Benefits and Costs, and Benefit per Dollar*

| Target | Annual benefits ($m)* | Annual costs ($m) | Benefit for Every Dollar Spent |
|---|---|---|---|
| Aspirin therapy at the onset of AMI (75% coverage) | $836 | $27.40 | $31 |
| Reduce salt content in manufactured foods by at least 30% | $12,121 | $638 | $19 |
| Increase tobacco price by 125% through taxation | $37,194 | $3,548 | $10 |
| Secondary prevention of CVD with polydrug (70% coverage) | $13,116 | $3,850 | $3 |
| **Total** | **$63,267** | **$8,063** | $8 |

*Authors assume 1 DALY averted = $1,000 USD, 3% discounting

# Introduction

The importance of NCDs as a major contributor to mortality and morbidity in LMICs is now well acknowledged[6] and reasonably well quantified.[7] Awareness of the import and impact of NCDs in global health has grown for more than two decades[8] and programs, policies, and interventions are being developed and widely tested. Success in lowering NCD mortality rates in HICs has been dramatic, although solutions are less at hand in LMICs. This paper argues that cost-effective prevention and treatment solutions are available, and ready to be scaled-up and implemented across the globe. There is also a general consensus that the vertical, top-down solutions upon which the global health community has thrived are not promising nor promised for application to NCDs.[9] According to Sridhar *et al* (2013), "Despite evidence of links between non-communicable diseases (NCDs) and development, these diseases and their risk factors were not included in the Millennium Development Goals (MDGs).[10] This pattern will not repeat itself with the post-2015 development goals, as NCDs are expected to be central to the health goals.

This paper discusses the role of NCDs in the development goal discourse, especially how NCDs fit into the overall health goal and why it is essential to have an NCD target in order to meet Goal 3 of the proposed SDGs: *Ensure healthy lives and promote well-being for all at all ages*. We argue in this paper that there are good investments to be made in NCD prevention and treatment, and that these investments will improve in value as the epidemiological and demographic transitions progress, and as developing countries establish greater health system capacity to provide NCD services and implement related policies. We focus our discussion and quantitative analysis on four interventions (removing one intervention from a previous version of the working paper) that address one target in the Post-2015 Sustainable Development Goal Framework: *by 2030, reduce premature mortality from NCDs through prevention and treatment and promote mental health and well-being.* The interventions presented and analyzed here will reduce mortality by 28.5% in 2030, primarily from cardiovascular and respiratory diseases, as well as some cancers.

The next section discusses the prevalence and scope of NCDs, with a focus on the developing world, where NCDs are rising in importance. Section III then presents the proposed health SDG, and the NCD-related targets, along with our rationale for selecting certain interventions to address the central NCD mortality target. Section IV presents our methods for calculating the benefits and costs of intervening to reduce NCDs, and Section V provides the results. Section VI discusses the feasibility and implications of meeting the NCD target with the combination of prevention and treatment interventions we analyze, and Section VII concludes.

# Rationale for Addressing NCDs in Development

NCDs are the largest cause of mortality both globally and in the majority of low- and middle- income countries (LMICs). NCD mortality exceeds that of communicable, maternal, perinatal and nutritional conditions combined.[11] Worldwide, NCDs account for 65% of global deaths,[7] accounting for a majority of deaths in all regions except Africa and almost half of current deaths in Africa. Eighty percent (28 million people) of NCD deaths occur in

LMICs, making NCDs a major cause of poverty and an urgent development issue. Bloom et al (2013) estimated that $47 trillion in economic output would be lost due to NCDs by 2030, concluding that "inaction would likely be far more costly [than interventions for NCDs.][12]

NCDs are wrongly perceived as diseases only of the rich. There has been a dramatic transition from infectious disease to NCD burden – in Mexico, for example, NCD was the cause of death in 45.4% of cases in 1980, but this increased to 74.4% by 2009. The reach of NCD risk factors is striking: a study in Argentina, Chile and Uruguay found that 43.4% of the population has high blood pressure, 11.9% have diabetes and 35.5% are obese. Nineteen percent of Kenyan HIV patients are obese and 8.2% have high blood pressure. Ninety percent of NCD deaths before age 60 are in LMICs, resulting in loss of household heads, wasted education investments, and huge out of pocket costs to families. Most of these deaths are from preventable causes, such as tobacco use, unhealthy diets, alcohol consumption, and physical inactivity. Lack of access to affordable medicines and health care services are also major causes of these preventable deaths.

Adding urgency to the NCD debate is the likelihood that the number of people affected by NCDs will rise substantially in the coming decades. Globally, the NCD burden will increase by 17% in the next ten years, and in the African region by 27%. The highest absolute number of deaths will be in the Western Pacific and South-East Asia regions. From a demographic perspective, both rising and aging populations are behind the projected increase in NCDs. From an epidemiological perspective, rising exposure to the main risk factors will also contribute to the urgency, particularly as globalization and urbanization take greater hold in the developing world.

## NCD Targets and Indicators

Following the Political Declaration on NCDs adopted by the UN General Assembly in 2011, WHO developed a global monitoring framework (GMF) to enable global tracking of progress in preventing and controlling major NCDs - cardiovascular disease, cancer, chronic lung diseases and diabetes - and their key risk factors.[13] As part of the GMF, the World Health Assembly in 2013 adopted 9 voluntary global NCD targets to be reached by 2025. Those targets were accompanied by 25 indicators, covering NCD mortality and morbidity, risk factors, and national health system response. That process paved the way for NCDs to become a central component in the post-2015 development goals. It provided ready-made outcomes from a completed consensus process within the NCD communities, and significant buy-in within the UN system.

The proposed post-2015 NCD target (3.4) for the SDGs is drawn directly from that agreed outcome – adjusted to fit the 2030 end date. The eventually chosen indicators are expected to closely track the GMF global targets. Table 2 presents the proposed post-2015 NCD target and the 9 WHO-agreed NCD targets in the GMF. It is reasonable to assume that some of the 9 targets will become indicators to track progress toward the NCD target. The table presents the definition or indicator for each target from the WHO Framework, along with the rationale for including the indicators analyzed in this paper.[14] This paper provides

analysis of the benefits and costs of meeting the NCD target (3.4) by implementing four of the listed interventions, plus one additional intervention not listed as a GMF target.

*Table 2: Health and NCD Goals, Targets and Indicators*

| Goal, Target, Indicator | Definition or Indicator | Rationale |
|---|---|---|
| Goal 3: Ensure healthy lives and promote well-being for all at all ages | | |
| Proposed NCD Target 3.4 and GMF Target #1: By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being. | Refers to the unconditional probability of dying between ages 30 and 70 years from cardiovascular diseases, cancer, diabetes, or chronic respiratory diseases. | There is political agreement on the numerical part of the target from the WHO World Health Assembly. The target is felt to be sufficiently ambitious, realistic, and feasible. |
| GMF Target: A 30% relative reduction in mean population intake of salt/sodium. | Age-standardized mean population intake of salt (sodium chloride) per day in grams in persons aged 18+ years. | Moderate reduction in salt intake can lower systolic blood pressure by small but meaningful amounts. Salt reduction is a WHO "Best Buy". |
| GMF Target: A 30% relative reduction in prevalence of current tobacco use in persons aged 15+ years. | Prevalence of current tobacco use among adolescents. Age-standardized prevalence of current tobacco use among persons aged 18+ years. | Each 10% increase in tobacco tax leads to at least a 4% reduction in demand, about half of which is from current consumption. |
| GMF Target: A 25% relative reduction in the prevalence of raised blood pressure or contain the prevalence of raised blood pressure according to national circumstances. | Age-standardized prevalence of raised blood pressure among persons aged 18+ years (defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg). | High blood pressure is responsible for at least 50% of cardiovascular disease, particularly stroke and ischemic heart disease. |
| GMF Target: Achieve 50% coverage in drug therapy and counseling (including glycaemic control) to prevent heart attacks and strokes. | Proportion of eligible persons (defined as aged 40 years and over with a 10-year cardiovascular risk ≥30%, including those with existing cardiovascular disease) receiving drug | Multi-drug therapy for adults with heart disease lowers the 10-year risk of re-hospitalization or death from 50% to 16% (Peto, 2006) |

| | | |
|---|---|---|
| | therapy and counselling (including glycaemic control) to prevent heart attacks and strokes. | |
| GMF Target: Reduce harmful use of alcohol by 10% | Total (recorded and unrecorded) alcohol per capita (15+ years old) consumption within a calendar year in litres of pure alcohol, or age-standardized prevalence of heavy episodic drinking among adolescents and adults, or alcohol-related morbidity and mortality among adolescents and adults as appropriate, within the national context. | INSUFFICIENT EVIDENCE TO ASSESS BCR |
| GMF Target: A 10% relative reduction in prevalence of insufficient physical activity. | Prevalence of insufficiently physically active adolescents (defined as less than 60 minutes of moderate to vigorous intensity activity daily). Age-standardized prevalence of insufficiently physically active persons aged 18+ years (defined as less than 150 minutes of moderate-intensity activity per week, or equivalent). | |
| GMF Target: Halt the rise in diabetes and obesity | Age-standardized prevalence of raised blood glucose/diabetes among persons aged 18+ years (defined as fasting plasma glucose value ≥ 7.0 mmol/L (126 mg/dl) or on medication for raised blood glucose, or Prevalence of overweight and obesity in adolescents (defined according to the WHO growth reference for school-aged children and | |

| | | |
|---|---|---|
| | adolescents, overweight – one standard deviation body mass index for age and sex and obese – two standard deviations body mass index for age and sex), or<br>Age-standardized prevalence of overweight and obesity in persons aged 18+ years (defined as body mass index ≥25 kg/m$^2$ for overweight and body mass index ≥30 kg/m$^2$ for obesity). | |
| GMF Target: Achieve 80% coverage in essential NCD medicines and technologies, including generics, required to treat major noncommunicable diseases in both public and private facilities. | Availability and affordability of quality, safe and efficacious essential noncommunicable disease medicines, including generics, and basic technologies in both public and private facilities. | |

Many voices have contributed to develop the above targets and indicators, some of them with a broad NCD mandate, such as the NCD Alliance, and others with disease-specific interests, such as the World Heart Federation and the International Agency for Research on Cancer. They each have their favorite targets, but have substantially aligned their advocacy interests through the aegis of the NCD Alliance. Other NCD diseases have not been embedded in the Global Monitoring Framework, and thus the targets and indicators that pertain to them are less well formed at this stage. This includes mental and neurological disorders, about which debates continue on the specific wording to include in the proposed NCD target.

For the analysis in this paper, we have chosen to focus on the primary GMF-agreed NCD target, and the subsidiary GMF targets that reflect high priority diseases and with well-proven, cost-effective interventions available. We examine prevention and treatment interventions that will reduce mortality from cardiovascular disease, chronic obstructive pulmonary disease (COPD), and some cancers. We provide here a brief rationale for prioritizing those diseases, with descriptions of the selected priority interventions in the next section. Numerous consensus statements have been issued that recommend widespread implementation of these interventions, but coverage for most of them is currently low, especially in LMICs. NCD advocates and developing country policymakers are requesting practical guidance and tools for implementation.[15] Economic analysis is an essential piece of the guidance for setting priorities on NCD targets.

The proposed NCD target (3.4) to reduce premature NCD mortality by one-third refers to the unconditional probability of dying between ages 30 and 70 years from cardiovascular diseases, cancer, diabetes, or chronic respiratory diseases. Most NCD deaths in high-income countries occur after age 70. Further, NCD mortality has been in a long decline in high-income countries thanks to existing high coverage of effective prevention and treatment interventions. Thus, the target will only be achieved through dramatic reductions of NCD mortality in low- and middle-income countries. For this reason, we focus the analysis on the benefits to be obtained by substantially increasing the coverage and effectiveness of NCD interventions in LMICs.

## *Cardiovascular Disease*

About 35 million people have an acute coronary or cerebrovascular event every year. An estimated 100 million people in the world are known to have cardiovascular disease, which gives them a five times greater risk of an event compared to people not diagnosed with cardiovascular disease.[16,17] Treating those with known disease or at high risk of disease with drug therapy -- what is referred to as "secondary prevention" -- will avert many deaths through a targeted approach. Earlier analysis suggests the multi-drug package could effectively reduce chronic disease death rates by 1.5% per year, at an average yearly cost of $1.08 per person in 23 high-burden LMICs.[4] High-risk patients are relatively easy to identify because they have already accessed health services due to their heart disease history, or through non-invasive assessment of combined risk factors (tobacco use, weight, blood pressure, age, and sex). Guidelines for pharmacological secondary prevention are available from WHO and from national cardiology societies. For resource-limited environments, these generally include the use of four medications: aspirin, ACE-inhibitors, beta blockers and statins. All of these are available in cheap, generic formulations, although not all are affordable to low-income patients. Further, the simplicity of this regime suggests it can be brought to scale in low-resource settings through primary health or outpatient facilities.[4]

Treatment of acute heart attacks with inexpensive drugs is less demanding of system resources and also cost-effective.[18] This intervention is a WHO NCD "Best Buy." Given the high incidence of acute myocardial infarction (AMI) in some LMICs, it is a high priority to make drugs available to reduce mortality.

## *High Blood Pressure*

High blood pressure is considered a "silent killer," that causes fatal or debilitating cerebrovascular events. It is implicated in about half of all deaths from heart disease and stroke.[19] The global population with high blood pressure is estimated at about 1 billion,[2] with a prevalence of 46% among adults in Africa which is even higher than in HICs (prevalence of 35%).[20] The recommended interventions include opportunistic screening and treatment for those with raised blood pressure, and population education to encourage awareness and reduction of dietary salt. Studies have shown population level salt reduction to be cost-saving,[21] and drug treatment for those with raised blood pressure to be highly cost-effective.[22]

Salt reduction was identified by WHO as a "best buy" for NCD prevention and control[2] and attention is turning to finding the most effective methods to achieve it. Depending on the diet composition in a population, greater effect may occur through interventions to reduce salt in food processing or at the cooking or eating stages. The former approach is being tried in Latin America where Brazil, Argentina and Chile are among the countries with industry agreements to reduce salt in processing. The main limitation in salt reduction strategies is the unproven impact on changing behavior when salt is mostly added at the table often as a sole condiment to food. This is the dietary pattern in much of India and Asia for example.

Increasing numbers of countries are implementing national policies to reduce salt consumption. Population-based interventions to achieve salt reduction include information and behavior change to reduce use at the point of cooking and eating and changes by manufacturers in processed product formulation and food preservation through regulation or voluntary steps. Studies of consumer acceptance of reduced salt from developing countries have not yet been done, but experience in the US and other developed countries suggest that substantial reduction from current levels is feasible with little or no consumer resistance. Selecting the appropriate level of intervention to achieve the greatest possible reduction in salt intake requires understanding local consumption habits and food systems. For instance, Argentina and South Africa are focusing on salt reduction in bread.[23,24] Reducing salt in bread has been found to be very cost effective in Argentina with an ICER of (2007) I$1407 or a cost of US$703 per DALY gained. The cost-effectiveness of 15 to 30 percent reduction in salt intake in Mexico through the two channels of voluntary and legislated manufacturing changes and labeling was modeled. The average cost-effectiveness across the population is US$286 (in 2005 US$) per DALY gained.[25]

## *Tobacco Control*

The number of tobacco attributable deaths that will occur in 2030 given business as usual (BAU) has been estimated by a few different sources, with the WHO projecting more than eight million, and others claiming as many as 10 million total deaths, mostly in LMICs.[26,27] Although the health effects of tobacco can take years to become apparent, as many as half of tobacco attributable deaths occur in people under the age of 70. In addition to stroke and other heart diseases, COPD, TB, and lung and other cancers are caused by tobacco use.

Tobacco kills differently in different parts of the world. In China, the leading causes of death from smoking are chronic lung disease and lung cancer, with high rates of tuberculosis but relatively low heart disease.[28] In India, the leading causes of death from smoking are tuberculosis and heart disease, with relatively less lung cancer.[29] Reducing smoking levels has been demonstrated to be well within the control of public policy. The WHO Framework Convention on Tobacco Control provides a comprehensive package of evidence-based policies, and the WHO MPOWER package assists countries to implement the interventions. These include warning labels, mass media campaigns, advertising bans, and taxation. Of these, tobacco taxation is particularly effective – with a 10% price increase leading to a 4-8% drop in consumption.[26]

These policy measures have already reduced consumption in high-income countries, but smoking in developing countries is rising. From the evidence in many high-income countries, tobacco taxation is widely considered to be the most effective intervention to decrease use.[1,27,30] Taxes are under-utilized, accounting for about 54% of the final price of cigarettes in low and middle income countries, but 71% (as of 2006) in high income countries.[31]

# Methods

## *Number of deaths to be averted*

To assess the benefits and costs of achieving the proposed post-2015 NCD target, we first calculated the number of deaths to be averted in 2030. Generally speaking, premature deaths are defined as deaths that occur before average life expectancy is reached. Given what we know about potential life expectancy in some high-income countries, a reasonable estimate is 70 years of age.

There are several credible projections for the global number of deaths in year 2030 by age, sex, and cause. This analysis relies on the World Health Organization's (WHO) Global Health Estimates from 2013.[32] GHE 2013 estimates that of the projected 70 million deaths that will occur in 2030, 23.7 million deaths will occur in people between the ages of 30 and 69, and approximately 17.6 million of those deaths will be from an NCD.[32] According to this projection, 5.9 million deaths in 30-69 year olds would need to be averted to reach the aforementioned target.

Norheim et al (2014) projected the effect of avoiding 40% of premature deaths by 2030 using UN mortality trends from 1970-2010 and applying those country-standardized trends to projected 2030 population rates.[33] They estimate that between 17.5 and 23 million people between the ages of 50-69 and 0-69 respectively will die from NCDs in the year 2030, about 90% of which would occur in LMICs. Based on these estimates, 5.8 to 7.7 million NCD deaths would need to be averted to reach the aforementioned goal. The midpoint of this range is 6.8 million.

Combining these two data sources, we estimate that interventions would need to avert between 5.9-6.8 million NCD deaths in people between the ages of 30-69 to reduce the premature NCD mortality by one-third in 2030.

*Table 3. Projected deaths from non-communicable diseases in 2030*

| | Age range | Total projected deaths in 2030 (in millions) | Deaths to be averted to reach reduction goal (in millions) |
|---|---|---|---|
| World Health Organization Global Health Estimates 2013[32] | 30-69 | 17.60 | 5.87 |
| Norheim et al 2014[33] | 0-69 | 23.02 | 7.67 |
| Norheim et al 2014[33] | 50-69 | 17.57 | 5.86 |
| **Calculated Target** | **30-69** | | **5.87 – 6.77*** |

*6.77 is the midpoint between 5.86 and 7.67

## *Interventions to avert NCD deaths*

We considered four interventions that would need to be in place to come close to reaching the NCD target. Our methods for calculating the cost and benefits from each intervention are explained below in detail.

- **Tobacco tax** – Tax tobacco at sufficiently high rates to achieve a 50% relative reduction in user prevalence. In this target, we concentrate on low- and middle-income countries (LMICs) because many high-income countries (HIC) have already implemented significant tax increases.
- **Aspirin therapy for AMI**: Provide aspirin to 75% of patients at the onset of an acute myocardial infarction (AMI).
- **Salt reduction** – 30% reduction in the mean dietary intake of salt through voluntary reformulation of processed foods.
- **Secondary prevention of cardiovascular disease**– 70% coverage and 60% adherence to a multi-pill regimen for those at a high risk of a cardiovascular event.

## *Tobacco taxation*

Because tobacco taxation at reasonably high levels is already commonplace and use is declining in HICs, we consider the effect of raising the price of tobacco in LMICs only, where tobacco use is rising. The agreed GMF target is a 30% relative reduction in the prevalence of tobacco use.[14] Jha and Peto (2014) find that a reduction of about one-third could be achieved by doubling the inflation-adjusted price of cigarettes.[27] However, we calculate the benefits and costs of a more ambitious target that would achieve a 50% relative reduction in user prevalence. This goal is deemed to be achievable based on recent evidence.[5]

We know from decades of research and various studies that the average price elasticity of demand for tobacco products is between -0.4 and -1.2.[31] A conservative prevalence elasticity (percentage change in smoking prevalence in response to a 1% change in price) would be about half of the price elasticity. Assuming a prevalence elasticity of demand of about -0.4 (half of the average price elasticity for tobacco products), a tax that increased tobacco prices about 125% would lead to about 50% reduction in tobacco usage.

We are assuming that reducing tobacco consumption in ages 30-70 translates directly to reduction in premature mortality. The effects of tobacco cessation depend on the age at

quitting, the reduction in intensity of smoking if one does not quit, and other genetic and lifestyle factors. We assume, however, that tobacco taxation will not only cause current smokers to quit but also prevent initial uptake of smoking in young people.

It is difficult to estimate the cost of implementing policy reform, as countries vary widely in their ability to impose and enforce taxes, however several studies have made an attempt. One estimate puts the average annual cost per capita to implement a revised tobacco tax system at $0.10 USD for a 10% price increase. However, with a cumulative tax increase of 125%, it is likely that the cost including enforcement, would be significantly higher, and we here set it at $0.50 USD per person. In this calculation, we only considered the per capita population of LMICs as projected in 2030.[3,32] Implementing a revised tobacco tax would cost around $3.55 billion.

Although not included in our benefit-cost calculations, we then calculated the revenue incurred from the tax increase as this often makes tobacco taxes attractive to governments. Using the 2030 LMIC population numbers, we assumed 20% of men and 5% of women would be smokers based on current rates.[34] We assumed that average consumption in the smoking population is 12 packs of cigarettes per year at $1/pack, and then adjusted revenue downward to reflect an estimated 5% loss to smuggling and assumed 50% decrease in usage.[35,36] If we assume that the tax increase is at least 75% of the price, tax revenues in LMICs would exceed $2.5 billion.

*Table 4. Tobacco taxation, calculation inputs*

| Metric | Values | Source |
|---|---|---|
| Tobacco attributable deaths in 2030 (business as usual) | 10 million | Jha and Peto 2014[27] |
| Percent of tobacco attributable deaths that will occur in people <70 years old | 50% | Jha and Chaloupka 2000[31] |
| Target percent decrease in tobacco product consumption (based on the following) | 50% | Kontis et al 2014[5] |
| Price elasticity of demand for tobacco products | -0.4 – -1.2 (Midpoint -0.8) | Jha and Chaloupka 2000[31] |
| Prevalence elasticity of demand as a percentage of price elasticity of demand | 50% | Jha and Chaloupka 2000[31] |
| Increase in price of tobacco products to achieve relative reduction target | 125% | Calculation |
| Tobacco deaths averted in 2030 among 30-69 year olds | 2.5 million | Calculation |
| Average annual cost per capita to implement revised tobacco tax system | $0.50 USD | Asaria, Chisholm, et al 2007[3] |
| Projected population of LMICs in 2030 | 7.1 billion | WHO Global Health Estimates 2013[32] |
| Total Cost | $3.55 billion | Calculation |

## *Aspirin therapy*

Taking an aspirin at the onset of an acute myocardial infarction is a WHO Best Buy for preventing premature mortality. Aspirin therapy prevents as much as 2% of all CVD mortality. [2] We considered the projected 2030 deaths due to ischemic heart disease in the relevant age range, and applied the 2% burden reduction assuming that 75% of the population would have access to the low-cost drug.[2,32] The WHO estimates that the cost per treated case of an AMI patient who takes aspirin, including clinical visits and diagnostic tests, is between $13-$15 USD.[26]

*Table 5. Aspirin therapy, calculation inputs*

| Metric | Values | Source |
|---|---|---|

| | | |
|---|---|---|
| Projected global deaths from ischemic heart disease in 2030 among 30-60 year olds | 2.8 million | WHO Global Health Estimates 2013[32] |
| CVD burden averted with aspirin therapy for acute myocardial infarctions (AMIs) | 2% | WHO Best Buys 2011[2] |
| Projected IHD deaths averted in 30-69 year olds in 2030 | 56,212 | Calculation |
| Aspirin therapy for AMI, cost per treated case | $13 | WHO Best Buys 2011[2] |
| Aspirin therapy coverage | 75% | Author assumption |
| Total cost of providing aspirin therapy | $27.4 million | Calculation |

## *Population salt reduction*

Salt intake above recommended amounts is a risk factor for hypertension and related cardiovascular conditions. We therefore explored the costs and benefits of reducing population salt intake by 30%, equal to the GMF target. A 30% salt reduction over 10 years is estimated to avert 16 million deaths, of which about 6.7 million would occur under the age of 70.[3] We used this number, adjusted to reflect one year and the projected 2030 LMIC population, to estimate the premature deaths averted from reduced salt intake. The same study estimated the average annual cost per person to implement voluntary salt reduction in the 23 high-burden LMICs considered to be an average of $0.09 USD.[3] We estimate the annual population cost of the intervention.[32]

*Table 6. Population salt reduction, calculation inputs*

| Metric | Values | Source |
|---|---|---|
| Total deaths averted by reducing population salt intake by 30% over 10 years in 30-69 year old age range* | 6.7 million | Asaria et al 2007[3] |
| Population increase from 2015-2030 | 22% | WHO Global Health Estimates 2013[32] |
| Projected deaths averted in 30-69 year old age range in year 2030 | .815 million | Calculation |
| Average annual cost per person to implement voluntary salt reduction in processed foods | $0.09 USD | Asaria et al 2007[3] |
| Projected population of LMICs in 2030 | 7.1 billion | WHO Global Health Estimates 2013[32] |
| Total cost of implementing the intervention in LMICs in 2030 | $639 million | Calculation |

*Numbers from study represent only 23 low- and middle-income countries that represent 80% of the global salt burden

## *Secondary prevention of CVD*

Secondary prevention of cardiovascular disease generally means putting those at high risk of CVD, or those who have had a non-fatal coronary heart disease or cerebrovascular event, on a multidrug regimen including aspirin, blood-pressure lowering drugs, and cholesterol-lowering drugs. According to a recent model, this secondary prevention polydrug treatment can prevent approximately 20% of deaths, assuming a 60% adherence to the daily regimen.[4] We calculated the number of premature deaths that could be averted if at least 70% of high-risk people had access to secondary prevention care.[32]

The same study estimated that the average annual cost to provide secondary prevention treatment to an individual would be about $55 USD.[4] We used that figure to estimate the cost of reaching 70% of the high-risk population with the polydrug regimen. We assumed a high risk population of 100 million.

*Table 8. Secondary prevention of CVD with polydrug, calculation inputs*

| Metric | Values | Source |
|---|---|---|
| Projected number of deaths due to cardiovascular disease in 2030 ages 30-69 | 6.3 million | WHO Global Health Estimates 2013[32] |
| Secondary prevention coverage | 70% | Author assumption |
| Percent of deaths averted with polydrug over 10 year period, assuming a 60% adherence rate | 20% | Lim et at 2007[4] |
| Projected CVD deaths averted in 2030 in 30-69 year olds due to secondary prevention | .88 million | Calculation |
| Number of individuals who would benefit from a polydrug treatment, ages 30-69 | 100 million | Author Assumption |
| Average cost per treated individual | $55 | Lim et at 2007[4] |
| Intervention cost of providing polydrug treatment at 70% coverage | $3,850 million | Calculation |

## *Value of a statistical life*

After calculating the projected number of premature deaths averted for each of the interventions, we estimated the value of a statistical life, or an average of what the population would be willing to pay to reduce the risk of disability or death. A rule of thumb that was proposed by the WHO Commission on Macroeconomics and Health values a disability-adjusted life year (DALY) at one times the GDP per capita, and uses three times the GDP per capita for sensitivity analysis. The Copenhagen Consensus 2012 paper on Chronic Diseases set $1,000 USD as the average GDP per capita for LMICs based on World Bank Data.[1] We assumed each DALY was valued at this number, as well as $5,000 for sensitivity as used in the CC2015 consensus paper on health.[36]

We considered the average age of premature death and the assumed life expectancy to move from deaths averted to DALYs. Given the age range we are considering is 30-70 years old, we assumed that the average age of death in our analysis would be the midpoint of 50 years old. If the premature death was averted and the subject lived to or past life expectancy of 70 years old, that person averted 20 DALYs. We then applied a 3% and 5% discounting function to the projected future DALYs averted before multiplying them by the aforementioned monetary value.

To better interpret the benefit-cost ratio (BCR), we use the following cut-offs as described in the CC2015 consensus paper. A BCR of 15 or above was considered excellent, a BCR between 5-15 was considered good, and a BCR between 1-5 was considered fair. If an intervention had a BCR of less than 1, it was considered poor.

## Results

This section provides an overview of the most cost-beneficial interventions to achieve the post-2015 NCD target. There is a broad range of reasonable estimates of the cost-effectiveness of most interventions.[1,37] This results partly from (often highly) incomplete information and uncertainty. It results also, and even more importantly, from the responsiveness of the cost-effectiveness function to variations in prices, in the scale of the intervention (and of its substitutes and complements), and in the epidemiological environment.

Given these often broad ranges in CE ratios, and hence in BC ratios, it makes little sense to conclude with precise estimates or with attempts to quantify statistical uncertainty around the point estimates. Rather we have identified major opportunities for investment in interventions that address a large disease burden highly cost effectively. Even valuing DALYs at a conservative $1,000 the benefit to cost ratios associated with investing in these opportunities are enormously high. This suggests that our results are conservative.

Table 1 lists the four interventions that we selected. Calculations were derived from reliable estimates of the adult mortality (age 30-69) for the world arising from those health conditions, as described above. Benefits were valued at $1,000 per death following the value of statistical life discussed above. Costs of each intervention were taken from published estimates cited in Tables 4-8 to depict as closely as possible the full social costs of intervening but, absent social values in most instances, the costs reflect financial estimates. An indicative benefit-cost ratio is calculated.

*Table 9: Selected interventions to achieve post-2015 NCD target: benefits and costs, BCR (3% Discounting)*

| Target | Annual costs ($m) | Annual benefits ($m)* | | BCR | | Rating |
|---|---|---|---|---|---|---|
| | | DALY = 1000 | DALY = 5000 | DALY = 1000 | DALY = 5000 | ( DALY = 1000 ) |
| Aspirin therapy at the onset of AMI (75% coverage) | $27.40 | $836 | $4,181 | **31** | **153** | Excellent |
| Reduce mean population salt consumption by 30% | $638 | $12,121 | $60,607 | **19** | **95** | Excellent |
| Increase the price of tobacco by 125% | $3,548 | $37,194 | $185,968 | **10** | **52** | Good |
| Secondary prevention of CVD with polydrug (70% coverage) | $3,850 | $13,116 | $65,580 | **3** | **17** | Fair |
| **Total** | **$8,063** | **$63,263** | **$316,336** | **8** | **39** | |

*See sensitivity results with 5% discounting in Appendix

Table 9 ranks interventions by benefit cost-ratio—from 31:1 for aspirin therapy at the onset of an AMI to 3:1 for the multidrug therapy for cardiovascular disease prevention. Every intervention in the table has not only a high estimated benefit-cost ratio but also addresses major NCD disease burden. For example, despite considerable cost of $3.85 billion per year, secondary prevention with the multi drug regime would avoid annually about 881,600 fatal heart attacks and strokes a year.

The interventions we analyzed are considered among the most cost-effective means to avert premature NCD mortality.

Taking aspirin at the onset of an acute myocardial infarction offers the highest benefit-cost ratio among the interventions in our list. It garners $31 in benefits for each $1 invested. While the magnitude of lives saved is not as large as other interventions, the drug's low price and ease of administration makes it a feasible and affordable intervention.

Reducing population salt intake by 30% in the high-burden LMIC population would avert almost 1 million deaths and 16.3 million DALYs for approximately $639 million. Population salt reduction benefits society $19 for every $1 spent.

Tobacco taxation offers a good benefit-cost ratio. Assuming 10 million tobacco-attributable deaths in 2030, an increase in the real price of cigarettes by more than 125% would avert up to 2.5 million deaths. At a cost of about $3.5 billion, without taking tax revenue into account, $10 in benefits would be accrued for each dollar spent.

Secondary prevention of CVD was the least cost-effective of the considered interventions, but still was effective at saving $3 for every $1 invested and averted the second highest absolute number of deaths.

These analyses are consistent with a recent World Health Organization (2011) report that examined both population-wide and individual-focused measures that low- and middle-income countries can take to reduce the burden of chronic diseases, and with the 2015 Global Status Report on NCDs.[2] WHO found that, for US$ 2 billion per year (less than US$ 0.40 per person), low- and middle-income countries can adopt a set of feasible population-based measures that can reduce the burdens imposed including those by tobacco, unhealthy diet, and lack of physical activity. Adding interventions that focus on individuals would result in a total cost of US$ 11.4 billion, implying an annual per capita investment of less than US$ 1 in low-income countries and approximately US$ 3 in upper-middle-income countries. Our estimates are in the mid-range of WHO's estimates for fully implementing high-priority population and individual level Best Buys.

## Discussion

The opportunities identified above don't explicitly address the challenge of strengthening of health system capacity. It will be important to ensure that implementation includes related investments in human resources and institutions, with 'related' broadly defined. In the cases of tobacco taxation and salt reduction, this could include public sector capacity to impose change on the private sector. In the case of treatment for hypertension, AMI, and existing cardiovascular disease, public systems will need to incorporate new capacity and expertise, even though efficiencies might be gained by linking NCD care with existing chronic disease care, such as for HIV/AIDS.[38] This means we may be underestimating the full costs of health system improvements that are needed to scale up NCD interventions to the levels of coverage we have assumed. The costs used in our BCRs are "fully loaded," in that they account for administrative and delivery costs, but most LMICs currently provide virtually no NCD services, and will need to put in place systems to do so. In this respect, our results are parallel to the Copenhagen Consensus Tuberculosis Perspective Paper,[39] and are intended as a complement to the Copenhagen Consensus recommendations for health system strengthening.

One might consider there to be two broad approaches to strengthening health systems. One involves relatively non-specific investments in capacity and reforms of process. The second involves creating specific capacity to deliver priority services in volume and with high quality. In the second model capacity strengthening spreads out from high-performing initial nodes. The approach that this paper implicitly advocates is very much in the spirit of the latter. The below discussion describes system improvements that are especially relevant to NCDs.

NCDs are different from most infectious and child diseases in fundamental ways that suggest changes in traditional global health programming models are needed. The following characteristics of NCDs are useful to keep in mind while exploring program adaptations and development of new programmatic models.

**NCDs require complex care usually involving different kinds of caregivers, across different levels of care.** Incentives must be aligned across different actors for good diagnosis, monitoring, and case management, which is all the more challenging with complex situations. Adherence issues are also relevant, as patients may not follow the treatment indicated. This challenge is relevant for *Health Systems* coordination and monitoring. What has been termed the "care gap" refers to a discrepancy between best practice care and what is provided in the usual clinical practice in a given setting.[15] A substantial care gap exists in the implementation of proven NCD interventions, including the WHO "Best Buys" and the MPOWER guidelines for tobacco control and prevention. One study found that economic status of a country accounted for about two-thirds of the variation in use of recommended prevention therapy, while the other one-third related to individual patient factors.[40] Even in high income countries, a significant segment of patients with established heart disease are not adequately treated.[41] Most hypertensive people are asymptomatic for years prior to having a cardiovascular event that could kill them. This creates challenges to finding and treating high risk people, and the absence of obvious symptoms also impedes long-term adherence to medication.

**The quality of care is also particularly important for NCD prevention and control because patients are often unmotivated to seek care and uninformed about risks and potential outcomes.** Lack of information can undermine both the monitoring of care, and simply knowing what the appropriate course of treatment may be. Because NCDs progress in a more variable manner than acute conditions, and patients in LMICs often present late in disease progression, health care providers must be prepared to handle a broad range of conditions.

**Behavior can place an individual at greater risk for developing NCDs.** In turn, individuals might engage in risk taking behavior such as smoking or insufficient physical activity due to time inconsistent preferences, moral hazard or incomplete information about health consequences.

**NCD prevention and control require action outside the health sector and often through population based measures.** Yet coordination with actors outside the health sector can be difficult. The required interventions may not align with their incentives. Coordination in itself is costly, may involve significant political capital and upfront cost. Activities in non-health sectors may even produce negative externalities on health. However, non-health sectors do not necessarily bear the cost of negative health externalities.

A broad set of changes will be needed for countries to meet the proposed NCD Target for Sustainable Development Goal #3: *Ensure healthy lives and promote well-being for all at all*

*ages*. These must include more and better trained health care providers, simplifying treatment guidelines, formulations, and delivery, improving affordability, and more education and training for patients to take responsibility for their own disease management.

## Conclusion

NCDs are the dominant health issue in almost all countries and regions. Even in poor countries, they are not a future problem. They are very present and involve significant costs to society, to governments, and to individuals and households especially where governments and donors are not providing many services.[12,42] One might reasonably ask, then, why are NCDs not among the stated priorities of more developing country health strategies and, by extension, the major global health funders?

Many factors interact to establish issues as global and donor priorities.[43,44] Prominent among those that impede the advancement of investments and action for NCDs is the view that LMIC health systems are not "strong" enough, or sufficiently geared toward complex, chronic needs to effectively implement NCD prevention and control.[45] If this is true – and even if it is, it is true by degree – then one solution (the one taken by major external funders so far) is to wait until LMICs become wealthy enough to gradually add NCD services to their public health provision, and let the private market provide whatever services can be paid for privately. This approach is socially and morally vacuous, and raises the specter of undermining years of investments in LMIC health systems and economic development.

Fortunately, a diverse array of new programs and projects are underway to test the defeatist view that NCDs are too complicated for LMIC health systems to deal with. These include transferring knowledge and practice from existing areas of global health strength (such as HIV/AIDS)[46,47]; reconceptualizing primary health care to better align with population health needs (in SE Asia[48], and in Africa[49]); developing new partnerships and methods that challenge current health care models[50]; and filling in specific gaps in knowledge to strengthen existing systems[51]. All of these and other nascent efforts are establishing a new development paradigm that includes a broader definition of health and health systems.[52] This paper demonstrates opportunities for improving health and well-being by reducing mortality from NCDs globally, achieving the SDG health goal, and strengthening health system capacities.

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## References


1. Jha P, Nugent R, Verguet S, Bloom D, Hum R. Chronic Disease Prevention and Control. Copenhagen Consensus 2012 Challenge Paper. 2012.
2. From burden to 'best buys': Reducing the economic impact of non-communicable diseases in low- and middle-income countries, 2015 Global Status Report on NCDs. Geneva, Switzerland: World Health Organization, World Economic Forum, 2011.
3. Asaria P, Chisholm D, Mathers C, Ezzati M, Beaglehole R. Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. *The Lancet* 2007; **370**(9604): 2044-53.
4. Lim SS, Gaziano TA, Gakidou E, et al. Prevention of cardiovascular disease in high-risk individuals in low-income and middle-income countries: health effects and costs. *The Lancet* 2007; **370**(9604): 2054-62.
5. Kontis V, Mathers CD, Rehm J, et al. Contribution of six risk factors to achieving the 25× 25 non-communicable disease mortality reduction target: a modelling study. *The Lancet* 2014.
6. Political declaration of the high level meeting of the general assembly on the prevention and control of non-communicable diseases. United Nations General Assembly. New York, NY; 2011.
7. Murray CJ, Lopez AD. Measuring the global burden of disease. *New England Journal of Medicine* 2013; **369**(5): 448-57.
8. Nugent RA, Jamison DT. What can a UN health summit do? *Science translational medicine* 2011; **3**(100): 100cm25-cm25.
9. Galambos L, Sturchio JL, Whitehead RC. Noncommunicable Diseases in the Developing World: Addressing Gaps in Global Policy and Research. Baltimore, Maryland: Johns Hopkins University Press; 2013.
10. Sridhar D, Brolan CE, Durrani S, et al. Recent shifts in global governance: implications for the response to non-communicable diseases. *PLoS medicine* 2013; **10**(7): e1001487.
11. Commission OM. Now for the long term, the report of the Oxford Martin Commission for Future Generations. *University of Oxford* 2013.
12. Bloom D, Cafiero E, Jané-Llopis E, Abrahams-Gessel S, Bloom L, Fathima S. The global economic burden of non-communicable diseases. 2011. World Economic Forum, Geneva; 2012; 2012.
13. NCD Global Monitoring Framework. Geneva, Switzerland: World Health Organization, 2012.
14. Draft comprehensive global monitoring framework and targets for the prevention and control of noncommunicable diseases. Geneva, Switzerland: World Health Organization, 2013.
15. CVD Prevention Roadmap Summit. http://www.world-heart-federation.org/publications/heart-beat-e-newsletter/heart-beat-july-2014/advocacy-news/cvd-roadmap/ (accessed January 5 2015).
16. Yusuf S. Two decades of progress in preventing vascular disease. *The Lancet* 2002; **360**(9326): 2-3.

17. Kerr AJ, Broad J, Wells S, Riddell T, Jackson R. Should the first priority in cardiovascular risk management be those with prior cardiovascular disease? *Heart* 2009; **95**(2): 125-9.
18. Gaziano TA, Opie LH, Weinstein MC. Cardiovascular disease prevention with a multidrug regimen in the developing world: a cost-effectiveness analysis. *The Lancet* 2006; **368**(9536): 679-86.
19. WHO. A global brief on hypertension: Silent killer, global public health crisis. WHO/DCO/WHD/2013.2. Geneva, Switzerland: World Health Organization, 2013.
20. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. *World Health Organization* 2013.
21. Wang G, Labarthe D. The cost-effectiveness of interventions designed to reduce sodium intake. *Journal of hypertension* 2011; **29**(9): 1693-9.
22. Barton P, Andronis L, Briggs A, McPherson K, Capewell S. Effectiveness and cost effectiveness of cardiovascular disease prevention in whole populations: modelling study. *BMJ* 2011; **343**.
23. Rubinstein A, Colantonio L, Bardach A, et al. Estimation of the burden of cardiovascular disease attributable to modifiable risk factors and cost-effectiveness analysis of preventative interventions to reduce this burden in Argentina. *BMC Public Health* 2010; **10**(1): 627.
24. Bertram Y, Steyn K, Wentze-Viljoen E, Tollman S, Hofman J. Reducing the sodium content of high-salt foods: effect on cardiovascular disease in South Africa. *SAMJ: South African Medical Journal* 2012; **102**(9): 743-5.
25. Salomon JA, Carvalho N, Gutiérrez-Delgado C, et al. Intervention strategies to reduce the burden of non-communicable diseases in Mexico: cost effectiveness analysis. *Bmj* 2012; **344**.
26. Alwan A. Global status report on noncommunicable diseases 2010: World Health Organization; 2011.
27. Jha P, Peto R. Global effects of smoking, of quitting, and of taxing tobacco. *New England Journal of Medicine* 2014; **370**(1): 60-8.
28. Liu B-Q, Peto R, Chen Z-M, et al. Emerging tobacco hazards in China: 1. Retrospective proportional mortality study of one million deaths. *Bmj* 1998; **317**(7170): 1411-22.
29. Jha P, Jacob B, Gajalakshmi V, et al. A nationally representative case–control study of smoking and death in India. *New England Journal of Medicine* 2008; **358**(11): 1137-47.
30. Blecher E, Van Walbeek C. An international analysis of cigarette affordability. *Tobacco Control* 2004; **13**(4): 339-46.
31. Jha P, Chaloupka FJ. The economics of global tobacco control. *BMJ: British Medical Journal* 2000; **321**(7257): 358.
32. Global Health Estimates Summary Tables: Projection of Deathsy by Cuase, Age, and Sex. July 2013 ed. Geneva, Switzerland: World Health Organization; 2013.
33. Norheim OF, Jha P, Admasu K, et al. Avoiding 40% of the premature deaths in each country, 2010–30: review of national mortality trends to help quantify the UN Sustainable Development Goal for health. *The Lancet* 2014; **385**(9964): 239-52.
34. WHO Report on the Global Tobacco Epidemic, 2013: Enforcing bans on tobacco advertising, promotion and sponsorship. Geneva, Switzerland: World Health Organization, 2013.

35. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The lancet* 2013; **380**(9859): 2224-60.
36. Hum R, Jordan K, Gauvreau CL, Jha P. Health: Reducing Premature Mortality by 40% in the Post-2015 Consensus. *Copenhagen Consensus* 2015.
37. Jamison DT, Breman J, Measham A, Alleyne G, Claeson M, Evans D. Disease Control Priorities Project. *Disease control priorities in developing countries* 2006.
38. Sweeney S, Obure CD, Maier CB, Greener R, Dehne K, Vassall A. Costs and efficiency of integrating HIV/AIDS services with other health services: a systematic review of evidence and experience. *Sexually Transmitted Infections* 2011.
39. Vassall A. Benefits and costs of the tuberculosis targets for the post-2015 development agenda. *Copenhagen Consensus* 2014.
40. Yusuf S, Islam S, Chow CK, et al. Use of secondary prevention drugs for cardiovascular disease in the community in high-income, middle-income, and low-income countries (the PURE Study): a prospective epidemiological survey. *The Lancet* 2011; **378**(9798): 1231-43.
41. Kotseva K, Wood D, De Backer G, De Bacquer D, Pyörälä K, Keil U. Cardiovascular prevention guidelines in daily practice: a comparison of EUROASPIRE I, II, and III surveys in eight European countries. *The Lancet* 2009; **373**(9667): 929-40.
42. Kankeu HT, Saksena P, Xu K, Evans DB. The financial burden from non-communicable diseases in low-and middle-income countries: a literature review. *Health Res Policy Syst* 2013; **11**: 31.
43. Shiffman J. A framework on generating political priority for global health issues. *Injury Prevention* 2010; **16**(Suppl 1): A280-A.
44. Shiffman J. A social explanation for the rise and fall of global health issues. *Bulletin of the World Health Organization* 2009; **87**: 608-13.
45. Ali MK, Rabadán-Diehl C, Flanigan J, Blanchard C, Narayan KV, Engelgau M. Systems and capacity to address noncommunicable diseases in low-and middle-income countries. *Science translational medicine* 2013; **5**(181): 181cm4-cm4.
46. Lamptey P, Merson M, Piot P, Reddy KS, Dirks R. Informing the 2011 UN Session on Noncommunicable Diseases: applying lessons from the AIDS response. *PLoS medicine* 2011; **8**(9): e1001086.
47. Mattke S. Learning from the HIV/AIDS experience to improve NCD interventions. In: Galambos L, Sturchio JL, eds. Addressing the Gaps in Global Policy and Research for Non-Communicable Diseases. Baltimore, Maryland: Johns Hopkins University; 2013.
48. Narain JP. Integrating services for noncommunicable diseases prevention and control: Use of primary health care approach. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine* 2011; **36**(Suppl1): S67.
49. The PIH Guide to Chronic Care Integration for Endemic Non-Communicable Diseases. Boston, Massachusetts Partners in Health, 2013.
50. Alleyne G, Nishtar S. Sectoral cooperation fro the prevention and control of non-communicable diseases. In: Galambos L, Sturchio JL, eds. Addressing the Gaps in Global Policy and Research for Non-Communicable Diseases. Baltimore, Maryland: Johns Hopkins University; 2013.

51. Smith L, Yadav P. Improving access to medicines for non-communicable diseases through better supply chains. In: Galambos L, Sturchio JL, eds. Addressing the Gaps in Global Policy and Research for Non-Communicable Diseases. Baltimore, Maryland: Johns Hopkins University; 2013.
52. Wood J, Babbington G. Healthcare in Asia: The innovation imperative. London: The Economist, 2011.

# Appendix

*Appendix Table 1: Selected interventions to achieve post-2015 NCD target: benefits and costs, BCR (5% Discounting)*

| Target | Annual costs ($m) | Annual benefits ($m)* | | Benefit for Every Dollar Spent | |
|---|---|---|---|---|---|
| | | **DALY = 1000** | **DALY = 5000** | **DALY = 1000** | **DALY = 5000** |
| Aspirin therapy at the onset of AMI (75% coverage) | $27.40 | $521 | $2,605 | 19 | 95 |
| Reduce salt content in manufactured foods by at least 30% | $638 | $7,553 | $37,765 | 12 | 59 |
| Increase the price of tobacco by 125% through taxation | $3,548 | $23,176 | $115,879 | 7 | 33 |
| Secondary prevention of CVD with polydrug (70% coverage) | $3,850 | $8,173 | $40,864 | 2 | 11 |
| **Total** | **$8,063** | $39,423 | **$197,113** | **5** | **24** |

This paper was written by Rachel Nugent, Clinical Associate Professor, Global Health at University of Washington. The project brings together 60 teams of economists with NGOs, international agencies and businesses to identify the targets with the greatest benefit-to-cost ratio for the UN's post-2015 development goals.

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