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Investing in non-communicable diseases: an estimation of the return on investment for prevention and treatment services

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The global burden of non-communicable diseases (NCDs) is growing, and there is an urgent need to estimate the costs and benefits of an investment strategy to prevent and control NCDs. Results from an investment-case analysis can provide important new evidence to inform decision making by governments and donors. We propose a methodology for calculating the economic benefits of investing in NCDs during the Sustainable Development Goals (SDGs) era, and we applied this methodology to cardiovascular disease prevention in 20 countries with the highest NCD burden. For a limited set of prevention interventions, we estimated that US$120 billion must be invested in these countries between 2015 and 2030. This investment represents an additional $1·50 per capita per year and would avert 15 million deaths, 8 million incidents of ischaemic heart disease, and 13 million incidents of stroke in the 20 countries. Benefit–cost ratios varied between interventions and country-income levels, with an average ratio of 5·6 for economic returns but a ratio of 10·9 if social returns are included. Investing in cardiovascular disease prevention is integral to achieving SDG target 3.4 (reducing premature mortality from NCDs by a third) and to progress towards SDG target 3.8 (the realisation of universal health coverage). Many countries have implemented cost-effective interventions at low levels, so the potential to achieve these targets and strengthen national income by scaling up these interventions is enormous.

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Introduction

The Sustainable Development Goals (SDGs) have increased global attention on the neglected non-communicable disease (NCD) pandemic. SDG 3, to ensure healthy lives and promote wellbeing for everyone at all ages, includes a specific subtarget on NCDs (target 3.4), to reduce premature mortality from NCDs by a third. As the burden of NCDs continues to increase worldwide, estimating the costs and benefits of an investment strategy to prevent and control NCDs and understanding the resources needed to progress towards SDG 3.4, have become matters of urgency.

In 2015, WHO[1] estimated that 40 million deaths worldwide had been caused by NCDs. In the 2016 Global Burden of Disease study,[2] NCDs were estimated to account for more than 70% of mortality worldwide. Cardiovascular diseases account for 17·7 million of these deaths, and about 80% of all deaths from NCDs are in low-income and middle-income countries (LMICs). The attainment of SDG 3.4 therefore necessitates a rapid scale-up of prevention and control interventions for cardiovascular disease. Treatment advances in recent decades have sharply reduced cardiovascular disease mortality in many high-income countries. By contrast, cardiovascular disease risk factors have worsened in many LMICs during the same period, and age-standardised cardiovascular disease mortality is high and, in some cases, still increasing.

The large and growing burden of NCDs has raised concerns about the economic consequences of this burden. NCDs are common in people of working age, so these consequences extend beyond the costs of treating the diseases. Reduced employment and productivity, for example, contribute to the loss of income at the household level and to the loss of economic output at a national level.[3] In a systematic review[4] of 126 studies about the economic effects of NCDs in a variety of country settings, labour force participation was lower in people with NCDs than in people without. Estimates from the USA have indicated that 4·7 working days are lost each year because of cardiovascular disease. In a Danish study, only 37% of people with a primary cardiovascular disease event had returned to work 30 days after the event, although long-term workforce participation returned to the pre-event level.[4] More strikingly, in a Nigerian study,[4] only 55% of

Key messages

- Investing in cardiovascular disease prevention and treatment is integral to achieving the SDG target 3.4 of reducing premature mortality from non-communicable diseases by a third and the SDG 3.8 target to achieve universal health coverage
- Effective and low-cost interventions are available but implemented at very low levels in most low-income and middle-income countries
- The investment to scale up this set of investments analysed here is likely to be large, but in addition to the intrinsic health benefits of this package, we would also expect economic benefits in terms of employment and productivity to increase national wealth

Panel 1: Brief methodology

To exemplify how investment in non-communicable diseases (NCDs) can deliver economic and social benefits, we focused this analysis on cardiovascular disease, which causes more than 50% of the non-communicable disease (NCD) burden worldwide. The analysis includes a group of 20 low-income, middle-income, and high-income countries that carry 70% of the global burden of cardiovascular disease (Bangladesh, DR Congo, Myanmar, Egypt, India, Indonesia, Nigeria, Pakistan, Philippines, Ukraine, Vietnam, Brazil, China, Iran, Mexico, South Africa, Thailand, Turkey, Poland, and Russia). The period of analysis is 2015–30, in line with the post-2015 Sustainable Development Goals. The full methodology is described in the appendix.

For the **International Labour Organization STAT database** see http://www.ilo.org/ilostat/

See Online for appendix

Calculating the health benefits of scaling up interventions

We use the NCD impact module of the inter-UN agency OneHealth Tool to calculate the health benefits of scaling up interventions. The impact modules developed for cardiovascular disease follow the structural format of the population models that have been used in WHO's cost-effectiveness programme WHO-CHOICE.[12] Two alternative scenarios are assessed using the OneHealth Tool cardiovascular disease impact module. In one scenario, the intervention coverage is scaled up to the target coverage levels in a linear fashion from 2015–30. In the second counterfactual scenario, intervention coverage is kept at the baseline level until 2030, assuming no additional investment is made to NCD prevention and treatment. The difference in number of fatal and non-fatal cardiovascular disease events between the two scenarios is the health gain attributed to additional investment in an intervention.

Estimating the health-care costs of interventions

Use of the OneHealth Tool to estimate health costs enables us to take an integrated approach to assessing costs and benefits. The numbers of health services required are dynamically estimated over time and are affected by population growth, mortality, and disease incidence as interventions are scaled up. The costing analysis uses an ingredients approach that multiplies needs-based quantities by country-specific unit costs for intervention delivery. The prices used to develop unit costs come from the International Drug Price Indicator Guide and the WHO-CHOICE price databases (updated to 2015).[13] Regulatory interventions are costed with the NCD costing tool.

For the **International Drug Price Indicator Guide** see http://mshpriceguide.org/en/home/

Estimating the economic and social returns on investment

The economic modelling of mortality follows the cohort of avoided deaths and incident cases for 2015–30. The effect of avoided mortality on the labour participation force is calculated by taking the numbers of deaths avoided, by age and sex, and applying a corresponding country-specific labour force participation rate for each age, sex, and year category (sourced from the International Labour Organization STAT database). The contribution that each of these labour force cohorts makes to economic output is calculated by multiplying the number of people in each age and sex category by a productivity rate that varies with age and year. The contribution of the cohort when suffering from cardiovascular disease is reduced because labour force participation for each age and sex category is set conservatively at 10% lower than that of the corresponding healthy category. We also assumed a reduction in productivity of 2·8% due to absenteeism and of 6·8% due to presenteeism for people with cardiovascular disease who continue to work.

Social benefits of increased years of healthy life

When estimating the benefits of improved health, it is also possible to put a monetary value on being alive. The common term for this type of statistic is the value of statistical life, but a more accurate term would be the value of (a small) risk reduction. Building on the results of Viscusi and colleagues,[14] Jamison and colleagues[8] estimated the value of a life-year as 1·4–4·2 times the gross domestic product (GDP) per capita, averaging 1·6 times the GDP worldwide. Stenberg and colleagues[9] modified this approach by assuming that the value of a life-year was 1·5 times the GDP per capita and that the economic benefit was equal to GDP per capita, leaving a residual value of 0·5 times the GDP per capita as the social benefit. Following this approach, we apply a value of 0·5 times the GDP per capita to each healthy life-year gained from the interventions to estimate the intrinsic value of longevity. Although the returns to an investment in health can be expressed using various related metrics, such as the internal rate of return, we use benefit–cost ratios to compare net present values (NPVs) of benefits and costs. These ratios were calculated by dividing the NPV of the economic benefits from mortality and morbidity avoided by the NPV of the costs of the intervention. To this we added the NPV of the social benefit. NPVs were calculated at a discount rate of 3%, as is common for analysis of health programmes.

patients who had a stroke returned to work 19·5 months after their stroke. In a UK study, 47% of patients had not returned to the workforce 1 year after their stroke.

In preparation for the 2011 UN high-level meeting on prevention and control of NCDs, the WHO Secretariat identified a core set of evidence-based, so-called Best Buy interventions for NCDs that met the criteria of being cost-effective, affordable, acceptable, and feasible.[5] Rolling out these interventions to global scale is estimated to cost US$170 billion for all LMICs during the period 2011–2025, which is equivalent to $1 per capita in low-income countries and $3 per capita in middle-income countries.[6] However, the value of the benefits to health or the economy that is associated with the costs of

intervention scale-up was not analysed, thereby precluding the possibility of determining the expected returns to investment from comprehensive prevention and treatment of NCDs. The Best Buy interventions were updated at the World Health Assembly in 2017 and were incorporated into an updated package of NCD interventions and and updated list of policy options for NCD prevention and control supported by the WHO member states.[7]

Broadly understood, the economic, health, and social benefits of NCD prevention and control include both the intrinsic (or social) value of improved health to individuals, households, and society at large and its instrumental (or economic) value in terms of being able to lead a fulfilling life, form and maintain relationships, study, work, pursue leisure interests, and make day-to-day decisions about education, employment, and housing. Estimating the magnitude of these benefits relative to the costs incurred to establish the return to investment can be done by estimating the existing and future levels of NCD burden and the effective current intervention coverage in a population and then determining the value of both the social and economic effects of improved health outcomes resulting from increased levels of intervention coverage.

The investment case for health, as a concept, is gaining traction in the public health literature, as is the notion that investment-case analyses provide important evidence that can inform decision making by governments and donors, particularly in a multisectoral context.[8,9] This thinking flows from a wider appreciation of the shortcomings of gross domestic product (GDP) as a measure of human wellbeing and a search for broader measures that include health and other goals of sustainable development.[10,11] Investment case for health is a term we use to refer to a method of policy analysis to justify the use of resources primarily intended to increase the stock of health (panel 1). A description of the theoretical underpinning of investment case for health is provided in the appendix.

Achieving SDG target 3.4 will have a variety of outcomes beyond the health sector that would contribute to the attainment of other SDG targets. These include contributions to SDG 8 (promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all), SDG 10 (reducing inequality within and amoung countries), and SDG 1 (ending poverty in all its forms everywhere). Here we propose a framework for undertaking investment-case analyses for NCDs, which links SDG 3 to SDG 8. Our proposed framework develops an investment case for NCDs, and we use cardiovascular disease as an example because of its high contribution to the total NCD burden. We present the health-sector costs of scaling up cardiovascular disease prevention interventions, in line with the SDG targets, and estimate the economic and social benefits of improved health.

***Panel 2*: Interventions included in the analysis**

Tobacco

- Increase excise taxes and prices on tobacco products
- Enact and enforce comprehensive bans on tobacco advertising, promotion, and sponsorship
- Implement large graphic health warnings on all tobacco packages
- Eliminate exposure to second-hand tobacco smoke in all indoor workplaces, public places, and public transport

Sodium reduction

- Engaging the industry in a voluntary reformulation process
- Implement front-of-pack labelling
- Initiate a behaviour change communication mass media campaign
- Establish a supportive environment in public institutions such as hospitals, schools and nursing homes to enable meals with low sodium content to be provided

Pharmaceutical interventions

- Combination drug therapy for those at 30% or greater risk of cardiovascular disease event in the next 10 years
- Drug therapy for people with systolic blood pressure higher than 160 mm Hg but total cardiovascular disease risk lower than 30%
- Drug therapy for people with total cholesterol concentration higher than 8 mmol/L but total cardiovascular disease risk lower than 30%
- Aspirin after acute stroke
- Combination drug therapy for people with ischaemic heart disease
- Combination drug therapy for people with stroke

What will it take to reach SDG targets?

Meeting the SDG goal of a 30% reduction in premature mortality from NCDs by 2030 requires strong action against a background of increasing NCD mortality in many countries. Emphasis is needed to prevent the onset of NCDs and prevent mortality in people with NCDs. The Global Action Plan for Non-Communicable Diseases (appendix) outlines a list of Best Buy interventions to guide policy makers towards the greatest value for money for their investments in NCDs. These interventions are considered affordable and feasible in most settings and include the most up-to-date evidence as a result of the 2017 updates.[7]

We focused our analysis on reducing cardiovascular disease mortality from 2015–2030 and used projection modelling of the health impact of a subset of these Best Buy interventions. These interventions were chosen because they have the greatest effect on cardiovascular disease and enable us to show the benefits of investing in both prevention and treatment programmes. Our analysis includes a package of interventions to reduce the demand for tobacco using the MPOWER strategy,[15] reduce sodium intake,[16] and increase access to pharmaceutical therapy for prevention and treatment of ischaemic heart disease and stroke (panel 2).[17] The strategy implementation

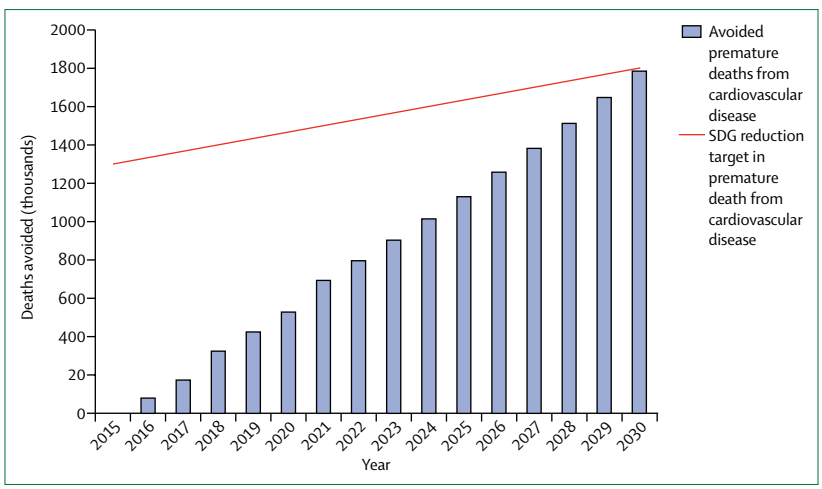

Figure 1: **Number of avoided premature deaths from cardiovascular disease in the 20 modelled countries between 2015 and 2030, relative to the Sustainable Development Goal target 3.4**

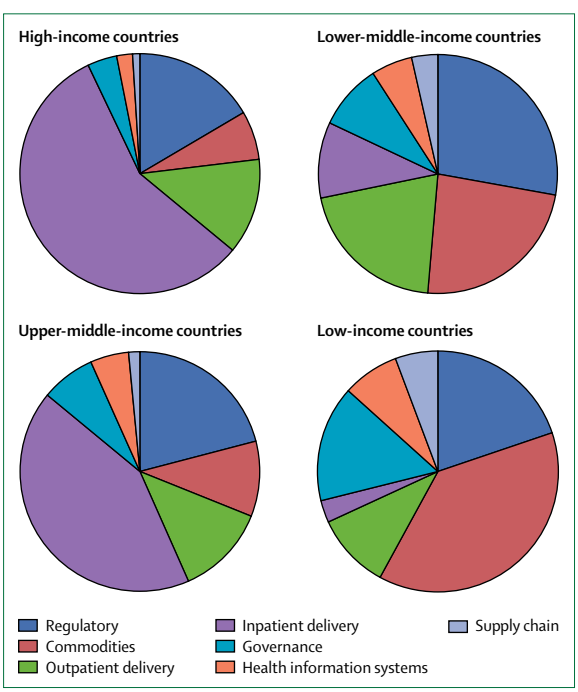

Figure 2: **Share of investment by health system component across income levels for the 20 modelled countries**

follows WHO guidance in each of the areas and assumes that the health impacts are in line with reported estimates.

We used projection models embedded in the OneHealth Tool to estimate the effect of increased coverage of these interventions on cardiovascular disease mortality in each of the 20 countries. Projections indicate that by 2025, 7·8 million people will die prematurely from cardiovascular disease alone if current trends continue.[18] Our projection model indicates that by 2025, about 1·13 million deaths (or 23% of premature mortality) could be avoided in the 20 countries, and 15 million lives would be saved in the 15-year period in these same countries (figure 1). By complete and efficient implementation of this package of interventions, it is almost possible to achieve SDG target 3.4 by 2030. Although preventive interventions focused on risk factors are the most cost-effective options, pharmacological therapy is the driving force behind this avoided mortality, yet pharmacological therapy is the most difficult of the interventions to scale up as ambitiously as in the modelled scenarios.

Estimating resource needs to scale up prevention and treatment of cardiovascular disease

We used the OneHealth Tool to estimate the costs of scaling up this set of interventions to control the increasing burden of cardiovascular disease and reduce premature mortality from cardiovascular disease. With cardiovascular disease causing 50% of the NCD mortality burden worldwide, understanding the health system, human resources, and financial needs to scale up action against cardiovascular disease is a key step in understanding the full magnitude of the challenge that health systems musts deal with in all income groups.

$120 billion in additional investment is needed for the 15-year period (discounted at a rate of 3%), which is equivalent to an additional investment of $1·50 per capita using a population-weighted average for the 20 countries included in the analysis. This varies between the income levels ($0·84 per capita in low-income countries, $1·43 per capita in lower-middle-income countries, $1·66 per capita in upper-middle-income countries, and $4·43 per capita in high-income countries). Health information systems governance and supply chain make up about 15% of costs each year, although this is probably an underestimate because of the increased number of health-care facility visits that would need to be supported by the health system to scale up cardiovascular disease care. This estimate is comparable to WHO's estimate of the cost of scaling up action for NCDs.[6]

The main driver for the difference in per-capita costs between country income groups is the varying incidence of cardiovascular disease risk factors and the costs of inpatient and outpatient medical care delivery (figure 2). During the 2015–30 period, per-capita expenditure increases by five-fold on average. With existing structures, high inpatient and outpatient delivery costs are important cost drivers in upper-middle-income and high-income countries, whereas the ten-fold increase in commodity costs by increasing coverage is an important driver for low-income countries. Fiscal and regulatory interventions for dietary risk factors and tobacco smoking make up only a small contribution to the total costs and might represent affordable options for some countries where the needed investment in health systems is unaffordable.

Understanding the economic and social returns on investment

In addition to the health benefits, investments for implementing or scaling up these interventions would bring a broader benefit to the economy. For the total sample, at a 3% discount rate and including social benefits, the benefit–cost ratio for cash flows until 2030 is 10·9. At a 7% discount rate, the benefit–cost ratio is about 7·5. A benefit–cost ratio of 5 implies that the discounted social return is five times the discounted value of the investment, which is widely considered high, so these results imply a strong return on investment for this set of interventions. Although we consider regulatory interventions to be the most cost-effective interventions in the long term,[7] the return on investment for pharmaceutical interventions during this 15-year period is almost equal to that of regulatory interventions. This is probably due to the immediacy of the health outcomes, whereas we would expect that over a longer timeframe, the return on investments would be higher from primary prevention activities than for pharmaceutical treatment.

The interventions in question have been applied and refined in high-income countries in the past decades and are highly effective in reducing cardiovascular disease events and mortality. The drugs used in these interventions are virtually all out of patent, and generics are are produced in large amounts and at low price in all parts of the world, which contributes to the low unit costs of the interventions. The risk factors are well known, so the application of these treatments can be targeted precisely to individuals with risk factors above a given threshold. The treatments have relatively immediate and, with continuing adherence, long-term effects. Finally, a substantial proportion of the reduction in cardiovascular disease events resulting from the interventions occurs relatively early in the lifecycle, leading to sustained economic and social benefits.

Benefit–cost ratios varied substantially between countries and across income levels (table). The income gradient was pronounced, with benefit–cost ratios higher for high-income countries than for LMICs. This income gradient was due to several factors, including the fact that the economic benefits of averting mortality or morbidity were valued in terms of country-specific GDP per capita. Although some costs in higher-income countries were higher than for lower-income countries, the ratio of GDP per capita to costs was higher in high-income countries than in low-income countries overall, and this high ratio was associated with increased economic benefits relative to costs in high-income countries.

	Total investment (NPV, US$ million)	Economic benefits (NPV, US$ million)	Social benefits (NPV, US$ million)	Benefit–cost ratio (economic returns)	Benefit–cost ratio (economic and social returns)
Tobacco*					
High income	1922	13 432	7866	6·99	11·1
Upper-middle income	8139	34 179	23 539	4·20	7·1
Lower-middle income	6843	17 598	6812	2·57	3·6
Low income	266	677	298	2·54	3·7
Overall summary	17 170	65 885	38 514	3·84	6·1
Diet					
High income	534	13 141	12 830	24·6	48·6
Upper-middle income	3647	32 723	38 432	9·0	19·5
Lower-middle income	6279	14 181	9029	2·3	3·7
Low income	803	505	375	0·6	1·1
Overall summary	11 262	60 550	60 666	5·4	10·8
Pharmaceutical					
High income	9530	96 967	100 075	10·2	20·7
Upper-middle income	39 446	283 094	337 653	7·2	15·7
Lower-middle income	39 145	163 627	93 431	4·2	6·6
Low income	3338	9103	5834	2·7	4·5
Overall summary	91 458	552 791	536 994	6·0	11·9
Overall summary					
High income	11 986	121 349	120 771	10·1	20·2
Upper-middle income	51 232	344 412	399 623	6·7	14·5
Lower-middle income	52 267	193 019	109 272	3·7	5·8
Low income	4407	10 208	6507	2·3	3·8
Overall summary	119 890	668 988	636 174	5·6	10·9

Definitions of economic and social benefits are available in the appendix. NPV=net present value. *Tobacco return on investment is calculated only on the basis of prevention of cardiovascular disease. Cancer and lung disease deaths will also be prevented, increasing the return on investment.

Table: **Economic returns and benefit–cost ratios associated with a scale-up to 50% coverage of interventions for cardiovascular disease in 20 countries between 2015 and 2030**

Considerations and recommendations

With this analysis, we present a framework to evaluate the global investment case for scaling up the response to cardiovascular disease. Previous work at the international level has addressed different aspects of this work, such as the mortality-attributable GDP benefits of eliminating disease,[19] the economic consequences of NCDs, the costs of scaling up a package of essential interventions for NCDs,[6] and the cost-effectiveness of interventions for NCD prevention and control.[20] This attempt to bring all pieces of data together to address the investment case for cardiovascular disease is the most comprehensive to date.

Several important findings should be considered by policy makers and donors. First, the potential for immediate health and economic benefits is great. Scaling up even the limited set of effective and preventive interventions analysed here could avert up to 13 million incidents of stroke and 8 million incidents of ischaemic heart disease within 15 years in addition to moving countries substantially towards the SDG target of reducing premature NCD mortality. Human capital, in terms of the number of labour force participants, would increase directly as a result of avoided mortality. Productivity would also increase as a result of avoided non-fatal events because individuals would avoid the disabling side-effects. Wider societal gains, such as the

Panel 3: Experiences of countries in undertaking non-communicable disease (NCD) cost and investment case analysis

Nepal

Nepal was the first country to pilot test the OneHealth Tool to cost their first NCD multisectoral action plan (MSAP) in 2015. The cost of implementing the MSAP increases four-fold by 2020 as the coverage of the interventions expands over the 5 year period.

Of the total estimated cost for implementation for the following 5 years, more than half of the cost estimated was on drugs and supplies. Most of the NCD-related drugs are covered under the 70 essential lists of free drugs published by the ministry of health and are thus funded from a separate source and disease programme. About 75% of the total estimated cost of drugs and supplies was reported to be associated with the treatment of chronic obstructive pulmonary disease (COPD), standard glycaemic control for diabetes, and asthma.

The three interventions with the largest share of cost and relatively high number of outpatient visits were for COPD, asthma, and screening for risk of cardiovascular disease and diabetes.

Barbados

Barbados was the first country to pilot test the investment-case approach used in this study at the country level in 2015. Both cardiovascular disease (hypertension, stroke, and heart attack) and diabetes were estimated to cost the Barbadian economy about BDS$210 million per year (US$1=BDS$2). This cost included BDS$64 million in direct costs for health-care interventions and $146 million in indirect costs due to losses in productivity. A return on investment of 3·9 was calculated for cardiovascular disease treatment interventions. The report is believed to have contributed to a push to scale up prevention actions for cardiovascular disease, including the implementation of a sugar-sweetened beverage tax.

Full details are available in the appendix.

continued consumption of goods and services by people who stay alive, would also be seen.

Second, the investment needed to deliver this set of cardiovascular disease prevention interventions (panel 2) will be high, and health systems need to be strengthened to support the interventions. This need is driven by the high prevalence of cardiovascular disease and a large treatment gap in most LMICs. However, the positive returns on investment, in terms of both health and social benefits, will become apparent. A further indication of the substantial health benefits of these interventions is the high numbers of avoided cardiovascular cases and avoided deaths from cardiovascular disease. Although the benefits would appear quickly, investment must be maintained to continue to see benefits. Without any further implementation of proximal preventive interventions, the number of people at high risk of cardiovascular disease will continue to increase. The global discourse around funding for the developing NCD agenda has largely focused on domestic financing options. In view of the funds required and the lack of international donors to fund NCD services, innovative financing options at the country level must be considered.

Third, investment alone in the commodities that are necessary for cardiovascular disease prevention will not ensure adequate delivery of these interventions. Health system strengthening and multisectoral action is a crucial component of the ability to scale up intervention coverage.[21] However, data to assess the exact needs are limited, despite continued discourse in this area.[21–24] The SDG agenda puts an enhanced focus on health system strengthening to support the move towards universal health coverage (UHC), but high-quality studies on these costs are needed. Without health systems investment, the attainment of the SDG targets is unachievable.

Finally, application of this methodology at the country level is crucial to the development of investment cases for NCDs. The results have been promising in countries that have applied the methodology to date (panel 3). Use of the freely available OneHealth Tool platform as the basis for the analysis allows countries to develop their own estimates of required investments to achieve NCD targets. Country-led investment cases will increase the accuracy of calculations by using local data on prices, coverage, and labour force participation. Country-led applications will also allow key enablers to be addressed through the concurrent development of a political economy assessment.

Although limited to cardiovascular disease (ischaemic heart disease and stroke), the methodology can be applied to other NCDs (eg, cancers, lung diseases) in countries and other health sectors. Using aligned methodologies, analyses have already shown average returns of investment of 8·7, 4·9, and 5·7 for reproductive, maternal, newborn, and child health,[9] mental health,[25] and adolescent health,[26] respectively, indicating that during the 15-year period, NCDs are an excellent investment option. However, notably for maternal and child health interventions, analysis through to 2050 increased the return of investment to 39. The pharmaceutical interventions for cardiovascular disease are front-ended in terms of their benefits but also need ongoing investment to have a continuing effect. By contrast, the economic benefits of interventions to improve maternal and child health are slow to build up, much in line with the benefits of preventive strategies for tobacco and unhealthy diets, because children must grow to maturity and mothers typically re-enter the labour force after their children mature. Most of the interventions are one-off costs that do not need to be repeated.

Previous work for the World Economic Forum showed that the burden of NCDs on national incomes worldwide (excluding mental health care) was $47 trillion over the 20-year period between 2010 and 2030.[19] More than 50% of this burden was from cardiovascular disease alone. Although most of this burden (54%) is borne by high-income countries, the burden in countries with lower national incomes is still considerable.

Some limitations of the analysis must be acknowledged. Savings and investment benefits are not enumerated in this study. These benefits are expected to have an effect on (future) employment and earnings, but a dynamic

model is necessary to estimate these effects. In the absence of a validated and robust dynamic estimation method, we have chosen not to enumerate these benefits.

We make the assumption that management systems for NCD services are already in place. This might not be the case in some countries, so costs would be underestimated in these instances, which highlights the need for country-specific analyses when discussing financing requirements. We assume that human resources are working at full capacity and that increasing the number of required services would have a direct effect on the number of health workers needed. We do not, however, account for the costs of increased capacity development in countries. We also do not explicitly account for avoided treatment costs. In the scale-up scenario, prevention interventions would decrease the number of events with time and thus reduce treatment costs. However, in the counterfactual scenario, we assume a low level of coverage of these treatment interventions, and thus there is no monetary gain from preventive interventions. We account for the economic costs of this prevention in the analysis of labour force participation.

We assume constant prices in real terms for goods and services over time, although we recognise that real unit costs could decrease (because of economies of scale, the emergence of new manufacturers, and innovative procurement and finance mechanisms) or increase (because of additional costs of reaching remote areas).

The analysis of the economic and health benefits of the interventions includes a range of assumptions, such as those about labour force participation, absenteeism, and presenteeism of people with cardiovascular diseases who are working. In some cases the underlying data are from a limited set of studies from high-income countries. Further primary research in this area is needed in LMICs to enhance the accuracy of the analysis.

To fully appreciate the global investment needs and the nuances of investment at different income levels, future research should focus on the application of this methodology to a more representative group of countries and, potentially, a broader range of interventions. With the increased attention to NCDs in the SDG era, continued analysis of the economics of NCD investment can only bring further attention and much needed debate to this area.

Contributors

MYB, JAL, DC, BR, PS, and KS contributed to the conceptualisation and methodological design of the study. MYB, JAL, and DC contributed to the development of the cardiovascular disease module of the OneHealth Tool. MYB did the analysis of health outcomes and costs. KS and MYB did the analysis of economic benefits. SRU, LPD, and MYB contributed to the costing of Nepal's NCD action plan. LPD, KG, and SD drafted panel 3. KG, SD, and MYB contributed to the development of the Investment Case for NCDs in Barbados. MYB developed the first draft of the paper. All authors provided input to further drafts and have read and approved the final paper for publication.

Declaration of interests

We declare no competing interests.

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