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ARTICLE

Best Investments in Chronic, Noncommunicable Disease Prevention and Control in Low- and Lower–Middle-Income Countries

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Abstract

The world remains off-track for the sustainable development goal (SDG) target 3.4, which calls for a one-third reduction in noncommunicable diseases (NCDs) mortality by 2030. This paper presents benefit–cost analyses of various NCD interventions in low-income (LICs) and lower–middle-income (LMCs) countries. We looked at 30 interventions recommended by the Disease Control Priorities Project, including six intersectoral policies (e.g., taxes) and 24 clinical services. We used a previously published model to estimate intervention costs and benefits through 2030, discounted at 8%. We focused on interventions with benefit–cost ratios (BCRs) > 15 and their contribution toward achieving the SDG target. We found that intersectoral policies often provided great value for money, with BCRs ranging from 40 (*trans*-fat bans) to 100 (tobacco excise taxes). However, seven clinical interventions (e.g., basic treatment of cardiovascular disease or breast cancer) also had BCRs > 15. The overall population impact of clinical interventions over the 2023–2030 period would be much higher than that of the intersectoral policies, which can take many years to reach their peak effects. Fully implementing the best-investment interventions would accelerate progress toward SDG 3.4 everywhere, but only one in 10 countries would achieve the target. This strategy would require an additional US$ 2.4 billion annually across all LICs and LMCs. We conclude that there are several cost-beneficial opportunities to tackle NCDs in LICs and LMCs. In countries with very limited resources, the best-investment interventions could begin to address the major NCD risk factors and build greater health system capacity, with benefits continuing to accrue beyond 2030.

1. Introduction

As with other sustainable development goal (SDG) targets, the world community remains off-track to achieving SDG target 3.4, which calls for a one-third reduction in premature mortality from noncommunicable diseases (NCDs) between 2015 and 2030. This target was set based on trends in NCD mortality in high-performing countries in the early 2000s

(Norheim *et al.,* 2015); more recent trends suggest a deceleration in mortality reduction compared to earlier periods. A report from the NCD Countdown Collaborators (2018) found that at the beginning of the SDG period, 18% of countries were on track to achieve the target; this number was revised down to 9% of countries in a 2020 report that used updated statistics (NCD Countdown Collaborators, 2020). Progress has generally been better for mortality from cardiovascular diseases and chronic respiratory diseases and worse for cancers and diabetes. In several countries, age-specific mortality rates from various NCDs are even increasing, especially in younger people. Tobacco use, harmful use of alcohol, and excessive sodium intake accounted for about a quarter of NCD deaths in 2019 (Global Burden of Disease [GBD], 2020).

On top of these unfavorable trends, the COVID-19 pandemic caused major disruptions to national healthcare systems and to NCD programs. While we do not yet know how the pandemic affected NCD death rates, we know that fewer people are receiving the care they need. For example, a World Health Organization (2021) survey found that in two-thirds of countries, health workers providing NCD services were redeployed to COVID-19 activities during the height of the pandemic, and in about half of countries, essential services like cancer screening and treatment of cardiovascular emergencies were either fully or partially disrupted. Making matters worse, the medium-term fiscal and macroeconomic outlook remains bleak for many low-income countries (LICs) and lower–middle-income countries (LMCs), because of sluggish growth and a deluge of government debt made worse by inflationary pressures (International Monetary Fund, 2022). The development assistance landscape is also changing, with only modest growth in aid overall, greater fragmentation, and an increasing share from private finance threatening funding for health systems in some LICs (World Bank, 2021). The challenge for ministries of health, as with governments in general, will be to do more with fewer resources. This challenge is even more relevant today than it was prior to COVID-19.

Although there is a great deal of wasteful healthcare being provided around the world, including for NCDs (Organization for Economic Co-operation and Development, 2017), value for money in NCD investments is not hard to find. A steady stream of reports since the early 2000s has underscored a range of cost-effective responses to the growing challenge of NCDs in LICs and LMCs. Groups such as the Disease Control Priorities Project (Jamison *et al.,* 2018) and the World Health Organization's (2017) CHOICE project have produced compelling analyses and normative recommendations that can serve as a starting point for national NCD strategies. There is broad consensus across these publications about the high value for money in population-level policies that can address dietary and lifestyle risk factors; what is less clear is the role of the healthcare system, which can deliver highly effective interventions but at considerable cost (Isaranuwatchai *et al.,* 2020).

The most recent report to consider priority investments in NCDs for 2030 was produced by the NCD Countdown Collaborators in early 2022. That report looked at 21 cost-effective interventions (e.g., tobacco taxes, cervical cancer treatment, and drug therapy for cardiovascular disease prevention) that could help achieve the SDG 3.4 target. Scaling up those interventions across 123 low- and middle-income countries would accelerate reductions in NCD mortality and help the world as a whole achieve the 3.4 target. The "price tag" would be an additional US$ 2.6 per capita per year on average between 2023 and 2030; this new spending would go toward the expansion of these interventions to as-yet unreached, high-risk populations. The authors also found that by 2030, countries will need to be spending, in total, about 20% of general government health expenditure on essential NCD services.

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The present report builds on the NCD Countdown Collaborators analysis, which we led, in several important ways. First, the primary objective of this report is to conduct a formal benefit–cost analysis of various NCD interventions in LICs and LMCs to guide health sector investments and intersectoral collaboration on risk reduction. Second, we look at an expanded list of interventions that addresses an expanded set of conditions, including mental and substance use disorders and deaths from self-harm (technically part of the 3.4 target). Third, in our analysis, we bundle together similar interventions that are delivered on the same clinical platforms and present the costs and benefits of these "packages," underscoring the potential costs and benefits of integrated approaches.

2. Methods

2.1. Intervention selection and aggregation

The starting point of this analysis is a set of interventions recommended in the third edition of the Disease Control Priorities series (DCP3) by Jamison *et al.* (2018). DCP3 was a set of nine volumes containing 172 chapters that covered all major areas of global health interest. The volumes were published between 2015 and 2018, with the final volume being a synthesis of the previous eight volumes. DCP3 chapters underwent peer review in a process overseen by the U.S. National Academy of Medicine. Each chapter covered a particular health topic (e.g., tuberculosis, cancer screening, and neurological disorders) and synthesized the evidence in a series of recommended interventions that (a) provide good value for money, (b) are feasible to implement in low- and middle-income countries, and (c) address a significant cause of death or disability.

These criteria were applied to systematic reviews of economic evaluations of health interventions conducted in low- and middle-income country settings, supplemented by other information such as clinical and implementation studies and expert judgment. The latter was especially important because robust cost-effectiveness information is lacking for many services that are being provided, and topical expertise is needed to be able to make sense of the literature. For example, DCP3 did not identify any published studies of the cost-effectiveness of cardiopulmonary resuscitation, but this intervention was recommended because it is an essential part of the emergency healthcare system and is nearly impossible to study using conventional economic evaluation techniques. In other words, DCP3 strove to avoid both "false negatives" and "false positives" (Jamison *et al.,* 2018).

DCP3's final list of recommended interventions was separated into 218 health sector interventions and 71 intersectoral interventions. The entire list of interventions is available in a series of appendices accompanying the DCP3 Capstone paper in the Lancet (Jamison *et al.,* 2018). For this analysis, we selected 30 interventions that are proven to reduce mortality from NCDs and can achieve meaningful impacts by 2030. The HPV vaccination for adolescent girls, for example, is highly cost-effective but has an at least 30-year lag between administration and significant health benefits, so it was not included in our analysis, which was focused on the SDGs. Our analysis looks at both clinical and intersectoral interventions through a benefit–cost lens.

Table 1 presents the interventions analyzed in this paper. A long-form description of each intervention and the evidence underlying its effectiveness and cost-effectiveness is provided in the appendix to the NCD Countdown Collaborators (2022, p. 15–34) report. The list in Table 1 starts with six intersectoral policies and is followed by 24 clinical interventions. The

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Table 1. *Interventions analyzed in this paper.*

Intervention name	Sub-components (if applicable)
Tobacco excise taxes	
Alcohol excise taxes	
Smoking regulations and IEC	
Alcohol regulations	
Sodium regulations and IEC	
Trans-fat bans	
Outpatient cardiometabolic and respiratory disease package	Diabetes screening/treatment
	CVD primary prevention
	Aspirin for suspected ACS
	CVD secondary prevention
	Heart failure chronic treatment
	Asthma/COPD chronic treatment
Outpatient mental, neurological, and substance use disorder package	IDU harm reduction measures
	Alcohol use screening/brief intervention
	Depression chronic treatment
	Bipolar disorder chronic treatment
	Schizophrenia chronic treatment
	Epilepsy acute and chronic treatment
First-level hospital cardiometabolic and respiratory disease package	Medical management of ACS
	Heart failure acute treatment
	Asthma/COPD acute treatment
First-level hospital surgical package	Screening and treatment of early-stage cervical cancer
	Management of bowel obstruction
	Management of appendicitis
	Repair of hernias
	Repair of gastrointestinal perforations
Referral hospital NCDs package	PCI for ACS
	Advanced care for severe acute asthma/COPD
	Treatment of early-stage breast cancer
	Treatment of early-stage colorectal cancer

Note: In general, "acute treatment" refers to treatment of disease complications in emergency or hospital settings, and "chronic treatment" refers to long-term pharmacological treatment with behavioral counseling when necessary (e.g., for treatment of mental disorders). We consider screening and any treatment response(s) to be part of the same intervention rather than separate interventions, for example, for CVD or diabetes care.Abbreviations: ACS, acute coronary syndrome; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; IDU, injection drug use; IEC, information and education communications; PCI, percutaneous coronary intervention; SSB, sugar-sweetened beverages.

latter are bundled into "packages" that correspond to shared delivery platforms or health worker competencies.

The reason that we present some interventions together in packages is to foreground the efficiencies that could be realized through integrated health service delivery and the importance of building health system capacity to co-implement a range of similarly cost-effective interventions (Bukhman *et al.,* 2020). For example, the interventions in the first-

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level hospital surgical package are all within the scope of practice of a general practitioner with training in surgical care and might have some synergies in terms of reduced costs or increased benefits. However, it is very challenging to quantify economies of scope in healthcare, so we do not attempt to model efficiency gains from integrated care in this paper, and our primary analysis is at the intervention level rather than the package level. We merely present package-level results (assuming constant economies of scope and scale) alongside individual intervention results to emphasize systems thinking in choosing and implementing these interventions.

In DCP3, all 30 of these interventions were deemed to be essential based on a general sense of their cost-effectiveness in relation to other (less cost-effective) interventions. However, the DCP3 authors did not conduct *de novo* cost-effectiveness or benefit–cost analyses of these interventions in different LIC or MIC settings; they merely reported findings from the literature. In contrast, this paper conducts *de novo* benefit–cost analyses of these 30 interventions to identify the very best investments in NCDs, using the DCP3 intervention list as the starting point. We seek to narrow down the DCP3 recommendations to a short list of highest-priority NCD interventions using comparable methods and assumptions. In this way, this study goes beyond what DCP3 was able to do analytically and provides deeper insights into intersectoral priority-setting for NCDs. It is possible that other interventions outside the DCP3 or WHO lists might represent "best investments" in some countries with unique disease burdens or health system features; however, we believe our list is comprehensive from a global standpoint.

2.2. Modeling intervention costs

Our cost estimates build on those done for a previous publication from the Disease Control Priorities Project (Watkins *et al.,* 2020) and the aforementioned NCD Countdown report (NCD Countdown Collaborators, 2022). Costs borne by governments in implementing the intersectoral policies were estimated on a per-capita basis using published costing studies or grey literature (e.g., government budget reports). For the clinical interventions, the focus was on unit costs (e.g., cost per patient-year of chronic treatment, cost per episode for acute care, etc.) to the healthcare sector. All interventions were assumed to be publicly financed (i.e., through universal health coverage systems), so out-of-pocket costs currently paid by households would be shifted to governments and accounted for in our estimates.

We primarily sourced unit cost data for the clinical interventions from DCP3's systematic reviews of cost and cost-effectiveness studies (see, e.g., a review of cardiovascular disease treatment costs by Brouwer *et al.,* 2015). Because NCD costing studies are few, we selected the highest-quality study that we identified that most closely reflected the medical components of the intervention in question. All costs were updated to 2020 US$ using procedures recommended by the Global Health Costing Consortium (Vassall *et al.,* 2017). They were then extrapolated to other countries in two stages. First, we decomposed costs into traded and nontraded components. Traded components were assumed to be constant across countries. Nontraded components were adjusted based on ratios of gross national income (GNI) per capita across countries. As described in the DCP3 costing paper and its appendix (Watkins *et al.,* 2020), this approach has several limitations but represents the most feasible approach for a global-level modeling study. Our costs were meant to be illustrative of the magnitude and range of costs across LICs and MICs rather than precise estimates used for budgeting

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country-level NCD programs. Country-level empirical (micro)costing of the 30 interventions was outside the scope of this paper.

Unit costs were then multiplied by the population requiring each intervention and further by the target coverage level of the intervention each year. For example, the cost of an intervention costing US$ 20 per patient-year that addressed a chronic disease with a prevalence of 1 million cases and a current coverage of 30% was calculated as US$ 20 × 1,000,000 × 30% = $6,000,000. The "incremental" cost of increasing coverage of that intervention by a certain amount would be calculated as the difference in coverage year over year. We defined full coverage of each intervention as 80% of the population covered by the year 2030, consistent with DCP3 (Jamison *et al.,* 2018) and WHO (Stenberg *et al.,* 2017) assumptions. Epidemiological and demographic data used to estimate population in need were taken from the World Health Organization (2020), Global Burden of Disease [GBD] (2020), and United Nations (2022). Coverage data were taken from the literature, the WHO, or expert opinion.

For the intersectoral interventions, there are two major types of costs that are borne outside the government/healthcare sector. The first type is the cost to firms of implementing government regulations. Again, we used literature-based estimates of these costs and extrapolated them across countries, like we did for the clinical interventions (above). The second type of cost is the forgone consumer surplus due to taxes and regulations on unhealthy products. We used recommendations from U.S.-based regulatory impact analyses (Food and Drug Administration, 2014) to inform our approach, which used an offset parameter that was applied to the estimated economic benefits from improved health (see below). For tobacco and alcohol policies, the offset value was 0.9, and for sodium and *trans*-fat policies, it was 0.5. These values were varied in scenario analyses (below).

All input data, including citations of the literature used to estimate the cost of each intervention are available at https://github.com/Disease-Control-Priorities/CCC.

2.3. Modeling intervention benefits

Our focus was on the economic value of improved health that could be realized from scaling up these interventions. Undoubtedly, there are other non-health benefits with economic value, such as reductions in medical impoverishment (from improved public finance), growth in health sector output, etc.; however, these are challenging to quantify and outside the scope of this analysis. Our benefit estimates are therefore inherently conservative.

We quantify improvements in health as a reduction in mortality and disability rates and therefore total deaths and disability-adjusted life-years (DALYs) following the scale-up of an intervention. To do this, we used a population model developed for the NCD Countdown Collaborators (2022) report. In brief, this model combined demographic projections of the United Nations (2022), including population counts and all-cause mortality rates, with cause-of-death data (World Health Organization, 2020) and disease incidence and prevalence rates (Global Burden of Disease [GBD], 2019).The baseline projection that we used as a reference for calculating intervention-specific health gains was calibrated to the UN Population Division medium projections, representing a business-as-usual scenario for intervention implementation.

Changes in disease-specific mortality and disability rates were a function of (a) the effectiveness of the intervention on these outcomes, usually expressed as a rate ratio or hazard ratio, and (b) the change in intervention coverage. Effectiveness data were usually

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taken from clinical trials, favoring meta-analytic estimates when available. We did our own searches for effectiveness data for the NCD Countdown report (see appendix mentioned previously). Intervention-specific effectiveness parameters are detailed in the online appendix (see the Github URL). We multiplied each literature-based effect size by 0.70 to account for imperfect implementation in real-world settings (NCD Countdown Collaborators, 2022) This parameter was varied in the scenario analyses (see below).

To calculate the economic value of reduced mortality and disability, we multiplied projected DALYs by the standardized time series estimates for the value of a DALY that were used throughout the Copenhagen Consensus project (e.g., for the year 2023, US$ 995 for LICs, US$ 4440 for LMCs, and US$ 3732 for the aggregate of both income groups).

One potential benefit of tobacco and alcohol taxes is a gain in revenue to governments. We took a societal perspective on costs and benefits, so these revenue gains are fully offset by additional costs to consumers, that is, they are, functionally, transfer payments.

2.4. Benefit–cost analysis and scenario analyses

To calculate intervention-specific benefit–cost ratios (BCRs), we looked at the incremental costs and benefits associated with scaling up each intervention between 2023 and 2030. In the baseline scenario, the current level of implementation (coverage) of each intervention was assumed to remain constant. In the "adjusted" scenario, the implementation level of each intervention was linearly increased up to a target level by 2030. For the intersectoral policies, this target was specified in the long-form description of the intervention. For example, by 2030 excise taxes should comprise 75% of the final price of tobacco products, so our model increases the price of tobacco products linearly from current reported prices and tax rates in 2023 to the target price in 2030. For the clinical interventions, this target was 80% population coverage by 2030. The difference in costs and benefits between the adjusted and baseline scenario for each intervention gives the incremental costs and benefits used to calculate BCRs.

As mentioned previously, two key parameters were varied in scenario analyses. We defined a base case scenario (presented in the main paper), a pessimistic scenario, and an optimistic scenario (both included in the online appendix tables). The first parameter was the offset value for calculating forgone consumer surplus, which was set at 0.94 for tobacco and alcohol policies (Jin *et al.,* 2015) and 0.70 for sodium and *trans*-fat policies in the pessimistic scenario and 0.86 and 0.30 (respectively) in the optimistic scenario. The second parameter was the multiplier for imperfect implementation, which was set at 0.50 in the pessimistic scenario and 0.90 in the optimistic scenario. In our primary analysis, costs and benefits were discounted at 8%, but we separately report results using 5% and 14% discount rates, including the costs and benefits in the pessimistic and optimistic scenarios.

2.5. Modeling achievement of the SDG 3.4 target

In the final part of our analysis, we specifically consider the "best investment" interventions and their role in getting countries back on track to achieving the SDG 3.4 target. We defined a best-investment intervention as one with a BCR of 15 or larger. We then modeled the impact of the combined set of best-investment interventions on premature mortality (using the age-specific mortality probability metric employed in the 3.4 target) and compared this to the impact of the entire set of 30 interventions and to the business-as-usual projection. Because

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interventions have synergistic effects on disease burden and demography, the costs and benefits of the full suite of interventions are not equivalent to the sum of the costs and benefits of individual interventions.

3. Findings

Because intersectoral policies and health sector (clinical) interventions are planned and implemented through separate policy processes involving different stakeholders, we discuss the main findings for both groups of interventions separately.

3.1. Intersectoral policy BCRs

Figure 1 presents the findings of our comparative BCAs of the 30 NCD interventions in LICs and LMCs. The top portion of the figure presents the BCRs for the six intersectoral policies, which were generally consistent across LICs and LMCs. Tobacco and alcohol taxes and regulations to discourage their use were generally very cost-beneficial, with BCRs ranging from 53 (alcohol excise taxes in LICs) to 100 (tobacco excise taxes in LMCs). Salt and *trans*-fat regulations had mixed results, being substantially more cost beneficial in LMCs than in LICs. The reason for this is that consumption of these goods is greater in LMCs than in LICs, and a greater share of NCD deaths in LMCs are linked to these goods, so the impact of these policies is greater.

The BCRs above incorporate very liberal estimates of forgone consumer surplus. Most health economists argue that these costs are negligible, but we include them to address any concerns among non-health economists about the potential welfare losses from reduced consumption. Tobacco excise taxes provide a helpful example. The standard economic model (i.e., consumers are fully informed and rational) would assume that reduced tobacco smoking leads to a loss of utility and should therefore be counted as a cost. Retrospective BCAs suggest that, if this assumption holds, many of the economic gains from improved health are offset by reduced utility – as much as ~90% in the case of tobacco taxes (Peck *et al.,* 2000). However, the evidence suggests that most smokers regret their decision to start smoking and demonstrate a consistent willingness to pay to *quit* smoking rather than keep smoking (Peck *et al.,* 2000). If we believe that there is no substantial welfare loss to consumers from reduced smoking, the BCR for tobacco excise tax would be 620 in LICs and 1,300 in LMCs.

3.2. Clinical intervention BCRs

Figure 1 also includes BCRs for the 24 clinical interventions. A few key findings emerged from our analysis. First, contrary to popular conceptions in the international development community, many clinical interventions to address NCDs provide good value for money. In LICs, 17 of the 24 interventions had BCRs greater than one, and in LMCs 22 of the 24 interventions had BCRs greater than one. Second, the clinical interventions were generally more cost-beneficial in LMCs as compared to LICs. The reason for this is very similar to the salt and *trans*-fat findings: LMCs have a higher NCD burden and greater impact on mortality for a given level of investment.

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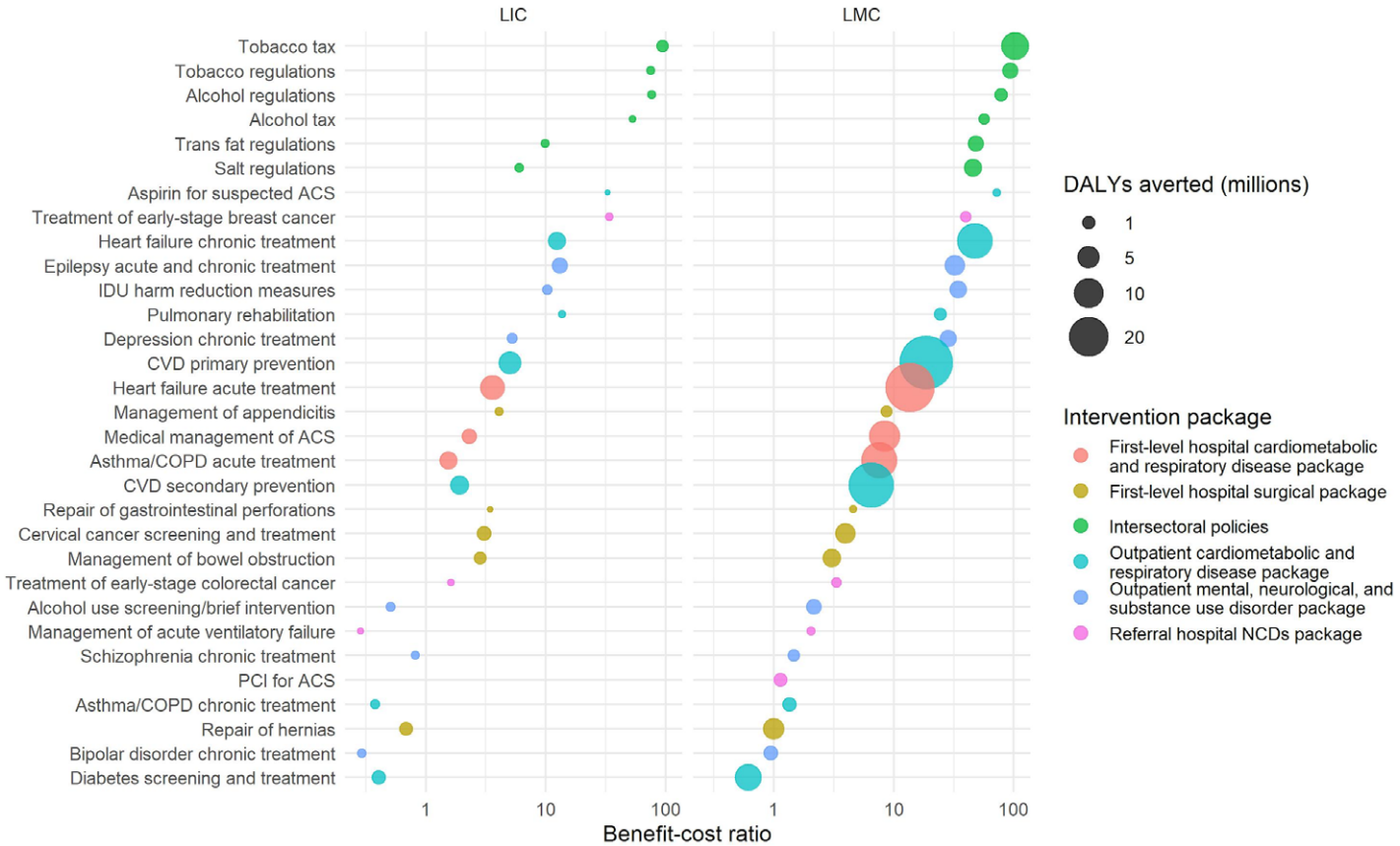

Figure 1. *Benefit–cost ratios and health impact of 30 NCD interventions in LICs and LMICs.*

Third, several clinical interventions had BCRs above 15 and therefore represent "best investments," on par with the preventive opportunities through intersectoral action. In LICs, these include treatment of early-stage breast cancer and aspirin for suspected heart attacks. In LMCs, in addition to these two interventions, several others were best investments, including treatment of chronic heart failure, harm reduction measures for injection drug users, epilepsy care, treatment of depression, pulmonary rehabilitation, and primary prevention of cardiovascular disease.

It is important to note, however, that the most cost-beneficial interventions were not necessarily the highest-impact interventions in terms of DALYs averted. This finding is illustrated in the relative size of the intervention "bubbles" in Figure 1. The full health impacts of many intersectoral policies can take years (if not decades) to be realized because they are mostly focused on disease prevention (NCD Countdown Collaborators, 2022). We evaluated BCRs over a relatively short time horizon (2023–2030 because this analysis was focused on priorities for the SDGs, and over that time horizon, clinical interventions focusing on secondary prevention and acute treatment could have a much larger impact on mortality than would preventive interventions.

The online appendix included with this paper presents the findings of the scenario analyses for LICs and LMCs, respectively. In the pessimistic scenario, only five interventions in LICs (tobacco excise tax, alcohol regulations, tobacco regulations, alcohol excise tax, treatment of early-stage breast cancer, and aspirin for suspected heart attacks) and 13 interventions in LMCs (tobacco excise tax, tobacco regulations, aspirin for suspected heart attacks, alcohol regulations, alcohol excise tax, treatment of chronic heart failure, *trans*-fat regulations, salt regulations, treatment of early-stage breast cancer, harm reduction measures for injection drug users, epilepsy care, treatment of depression, and pulmonary rehabilitation) could be considered best investments. In the optimistic scenario, 10 and 15 interventions (respectively) could be considered best investments. BCRs between the optimistic and pessimistic scenarios differed by a factor of two.

3.3. Accelerating progress to achieve the SDG 3.4 target

We next consider the potential costs and benefits of co-implementing these NCD interventions and their contribution toward the SDG 3.4 target. Our principal findings are provided in Table 2 and Figure 2.

If LICs and LMCs were to fully implement the best investment interventions ($n = 6$ and 14, respectively) by 2030, 12 million deaths and 82 million DALYs could be averted at an additional cost of US$ 19 billion in total, or US$ 2.4 billion annually. About one in 10 countries would be able to achieve the 3.4 target. The overall BCR of this approach would be 23.

On the other hand, if LICs and LMCs were to fully implement all 30 interventions by 2030, the costs and benefits would be considerably higher but with a lower BCR. In total, 27 million deaths and 200 million DALYs could be averted, at an additional cost of US$ 260 billion in total, or US$ 33 billion annually. About half of the countries would be able to achieve the 3.4 target. The overall BCR of this approach would be 4.1.

These findings refer to LICs and LMCs as groups; they do not imply that all countries would achieve the 3.4 target. Some countries would experience larger declines than average, and others would experience smaller declines. Large countries that would be able to perform better than average would be responsible for much of the progress at the regional level.

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Table 2. *Costs and benefits of scaling up NCD interventions and of achieving SDG 3.4.*

Intervention name	LICs	LMCs	All LICs and LMCs
Baseline characteristics of country groups			
Total population in 2022 (millions)	660	3,300	4,000
Estimated spending on NCD interventions in 2022 (US$ billions)	1.8	41	43
Total NCD deaths in 2022 (millions)	1.7	14	15
Projected NCD deaths in 2030, business as usual (millions)	2.1	16	18
Best investment interventions only			
Incremental cost over 2023–2030 (US$ billions)	0.010	19	19
Total annual cost per capita at full implementation in 2030 (US$)	0.0034	1.7	1.4
Percentage of countries achieving the SDG 3.4 target by 2030	0%	14%	9.1%
Deaths averted over 2023–2030 (millions)	0.19	12	12
DALYs averted over 2023–2030 (millions)	1.3	80	82
Economic benefits over 2023–2030 (billions)	1.9	510	430
Benefit–cost ratio	74	27	23
All interventions			
Incremental cost over 2023–2030 (US$ billions)	21	240	260
Total annual cost per capita at full implementation in 2030 (US$)	6.7	20	17
Percentage of countries achieving the SDG 3.4 target by 2030	48%	48%	48%
Deaths averted over 2023–2030 (millions)	3.1	24	27
DALYs averted over 2023–2030 (millions)	28	170	200
Economic benefits over 2023–2030 (billions)	40	1,100	1,100
Benefit–cost ratio	1.9	4.6	4.1

Note: Totals for "all LICs and LMCs" may not add up due to rounding; results are presented to two significant digits.

However, we emphasize that all countries would experience a substantial reduction in NCD mortality compared to the baseline, even if they did not end up achieving the 3.4 target.

4. Discussion and policy implications

This analysis reiterates and extends the findings from numerous reports over the past two decades, that is, that there is high value for money in tackling chronic NCDs. All countries have agreed to the one-third reduction target of the SDGs, but many lack the sort of concrete guidance on how to accomplish this target while being mindful of resources. We build on the NCD Countdown report by providing BCRs for different intervention options that can be directly compared to investments in other sectors linked to the SDGs. Our findings are not meant to be prescriptive for specific countries. They are merely a starting point for local

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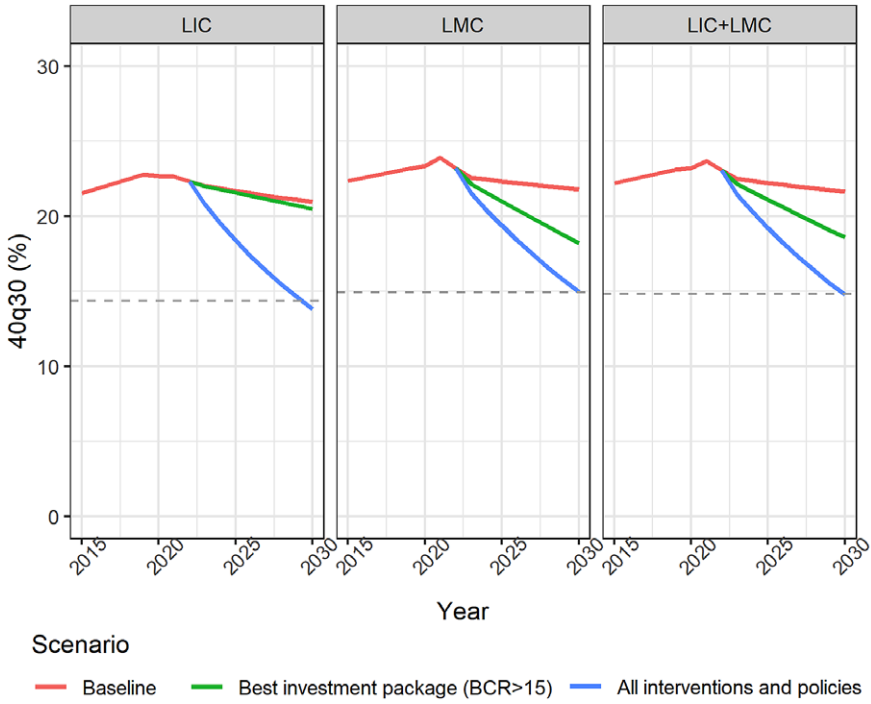

Figure 2. *Trends in NCD mortality with and without scale-up of NCD interventions. The red line shows the trend in NCD mortality (expressed as NCD-specific 40q30) if no intervention scale-up occurs. The green line shows the trend under the best-investment-intervention-only scenario, and the blue line shows the trend under the all-interventions scenario. The horizontal dotted line denotes the mortality level (in absolute terms) that these two country groups would need to reach by 2030 to achieve the SDG 3.4 target.*

analysis and deliberation. Our findings can also inform international collective action to address NCDs and provide guidance to development partners on the sorts of investments they can make to add value to national NCD strategies.

4.1. Implications for intersectoral policy

We find, unsurprisingly, that intersectoral policies often offer the best value for money in NCDs, mostly because they are highly effective and cheap to implement from governments' perspectives. However, many of the "costs" of these policies are political. They require great resolve against considerable commercial lobbying and resistance, especially from trade groups affiliated with tobacco, alcohol, and food and beverage companies (Delobelle, 2019). Most of the industry-led arguments against these policies have been debunked, for example, that tobacco taxes are regressive when they are actually pro-poor (Verguet *et al.*, 2015*a*; Global Tobacco Economics Consortium, 2018), but these messages need to reach policy-makers and legislators on the front lines. On the other hand, some industry objections are more reasonable; for example, sodium reduction policies impose non-negligible costs on firms. We show that, from a societal standpoint, these costs are worth bearing because of the

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large health returns. Finally, libertarian-leaning analysts often raise concerns about the welfare losses associated with policies that limit the choice to consume unhealthy products. While we disagree conceptually with this framing, we use very liberal assumptions about forgone consumer surplus to incorporate the welfare losses that are believed to be associated with taxes and regulations, and we still find that these policies are incredibly cost-beneficial, especially tobacco taxes. Again, these messages need to reach policymakers and legislators.

With BCRs exceeding 100 across all LICs and LMCs, tobacco excise taxes are by far the most cost-beneficial option for addressing NCD mortality worldwide. Nearly 20 years after the WHO's Framework Convention on Tobacco Control was opened for signature, progress on tobacco taxes has stagnated, in part because of economic growth and continued political influence of the tobacco industry across Asia and Africa (Delobelle, 2019). In many countries, tax increases have not kept pace with economic growth, meaning that tobacco products are becoming more affordable despite significant nominal tax rates. We recommend that 75% of the final price of tobacco products be comprised of specific excise taxes, if possible. This recommendation is a bit different from the WHO, which does not place as much emphasis on specific excise taxes as compared to other types of taxes. However, experience has shown that specific excise taxes are easier to administer, more difficult to evade, and overall more effective at reducing use (World Bank, 2017). What is most important is to frequently revise tax policies to keep up with economic growth and inflation to ensure that tobacco products do not become more affordable over time.

Tobacco control in India provides an important and concrete example of how our BCA works. Our model's starting point is the 2020 tax level in India, which was about 57% of the total price. In our analysis, we increased the price of an average pack of cigarettes linearly from US$ 2.54 to US$ 4.31 to hit a target of 75% of the total price. A price increase of this magnitude would reduce smoking by 33%, saving 910,000 lives in India, and substantially reducing disability among the population, realized as fewer sick days and higher economic productivity. The overall economic benefits would be US$ 35 billion. The estimated cost of fully implementing the tax increase would only be US$ 5.7 million on average per year, but it would generate US$ 50 billion annually in additional tax revenue to government by 2030, corresponding to 1.6% of GDP today. Our BCA does incorporate an estimated additional US $ 320 million in consumer welfare losses from reduced smoking prevalence. While this large value says something about the political cost of raising the tobacco tax, we stress that it should not change the decision to pursue more aggressive tobacco control measures because the benefits would outweigh the costs by at least 97 to one.

4.2. Implications for health systems and universal health coverage

While many publications have focused on intersectoral policy "best buys" for NCDs, relatively less attention has been paid to clinical interventions. While not all clinical interventions are best investments, there are a few that are important to consider alongside the intersectoral policies and which could address the needs of individuals seeking care for NCDs. We believe that these should be considered as part of a comprehensive approach to universal health coverage priority-setting and health benefits package reform. Put more simply, the few clinical interventions with BCRs over 15 would be the highest priority interventions to incorporate into entitlement programs, that is, guaranteed to the entire population and available at little-to-no out-of-pocket cost.

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Table 2 and Figure 2 underscore the important point that the best-investment interventions are necessary but not sufficient for countries to get back on track to achieving the 3.4 target. For better-resourced countries seeking to achieve the 3.4 target, we provide a menu of options beyond the best investments, for example, the 12 or so interventions with BCRs between about 3 and 15. Of course, these interventions should only be considered once the best-investment interventions are implemented. This overall approach to priority setting is in line with World Health Organization (2014) recommendations for universal health coverage.

The additional funding required to implement the best investments is modest, amounting to about three basis points of GNI across all LICs and LMCs. If all countries were to implement all 30 interventions at full scale, the additional funding would be about 40 basis points of GNI. It is important to underscore that many countries are currently underspending on health relative to international benchmarks by a factor of three or more (McIntyre *et al.,* 2017; Watkins *et al.,* 2020), so from a normative standpoint, these interventions should not be a heavy financial burden.

Still, history suggests it will be challenging for many countries to raise revenues to levels needed to implement even the best investments. World Health Organization (2022) data on health spending show that countries are increasing health spending at a sluggish pace, and there is little evidence that this additional spending is going toward NCDs. We argue that, like education and infrastructure, health has instrumental value to society and merits special consideration (and greater prioritization) within the development agenda (Sustainable Development Solutions Network, 2019), provided the resources spent on health are targeted to high-value programs. Enhanced revenue generation (e.g., improved efficiency of taxation systems) and reforms that promote economic growth are probably the most quantitatively important mechanisms for improving fiscal space for health in general (Barroy *et al.,* 2018), and especially for NCD interventions that are not a priority for official development assistance. Efficiency gains from reducing wasteful spending might also free up considerable resources (Organization for Economic Co-operation and Development, 2017; Barroy *et al.,* 2018).

4.3. Research in context and limitations

Our analysis offers some advantages and improvements over prior studies. Compared to a previous chronic disease challenge paper for the Copenhagen Consensus Center (Jha *et al.,* 2012), we had a broader range of interventions to look at, as well as improved data inputs and modeling techniques. Our BCR estimates are broadly in line with those for the interventions analyzed in the *Challenge Paper* (including tobacco taxes, sodium reduction, and basic treatment of cardiovascular diseases). Compared to WHO's related work in this area, we include more clinical interventions, which are of relevance to ministries of health, and find higher returns on investment because we use an approach informed by VSL estimates, rather than the instrumental/human capital approach used by WHO (see Bertram *et al.,* 2018). Finally, this paper builds on the NCD Countdown reports by explicitly considering two neglected areas of NCDs, namely, mental health and essential surgical care. Although these interventions would not be considered best investments, their inclusion here provides new insights into their relative merits in the context of the health system development agenda.

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Of course, our analysis had some notable limitations, many of which were reviewed in the NCD Countdown report (NCD Countdown Collaborators, 2022). For example, we did not have sufficient data to implement nonlinear cost functions or model economies of scope or scale. In addition, we are still uncertain as to the effect of the COVID-19 pandemic on NCD epidemiology (especially risk factor exposure) and medium-term health sector resource levels. Finally, we did not consider the non-health benefits of these interventions to households, such as reduced medical impoverishment from reduced disease incidence and out-of-pocket spending (Verguet *et al.*, 2015*a*, *b*), and we did not look at the equity impact of these interventions, many of which target populations that are not already accessing care (including the poor). Financial protection and equity are important health system objectives that merit additional study and incorporation into future BCA efforts, data permitting.

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