World Health Organization

Saving lives, spending less

Methodology

This report was prepared by the Economic Analysis and Evaluation team of the Department of Health Systems, Governance and Financing at the World Health Organization Headquarters. The analysis was carried out by Melanie Bertram, Robert Totanes and Emily Wymer, under the supervision of Tessa Tan Torres Edejer , Agnes Soucat, Douglas Bettcher and Etienne Krug. Mary Anne Land, Anne Marie Perucic and Virginia Arnold provided critical review of the estimates and contributed to the writing.

The suggested reference is Economic Analysis and Evaluation Unit. Methods of the Investment Case Analysis for the Non-Communicable disease global business plan.

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CONTENTS

ANALYTIC SCOPE

The analysis for the economic data underpinning the NCD Global Business Plan was overseen by an informal advisory group consisting of the individuals listed in table 1. The informal advisory group met in November 2017 to review the proposed methodology, scope and preliminary results, and provide direction on the final report.

Table 1: Informal Advisory Group members

Name	Organization
Kelly Henning	Bloomberg Philanthropies
Judith Mackay	Vital Strategies
Ala Alwan	University of WAshington
Johanna Ralston	World Obesity Federation
Dean Jamison	University of California, San Francisco
Thomas J. Bollyky	Council on Foreign Relations

This scope of the analysis follows the proposal of the informal advisory group and focuses on the 16 "best buys" for NCDs as described in the Appendix 3 of the Global Action Plan for NCDs, updated in 2017[1] (table 2). The best buys are a set of evidence based priority interventions for NCD prevention and control, which include considerations of cost-effectiveness, feasibility, affordability, acceptability and potential for successful implementation. The analysis covers almost all low and lower middle income countries[1].

Table 2: WHOs NCD 'Best Buys'

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, public transport
ALCOHOL
Increase excise taxes and prices on alcohol products
Enact and enforce bans or comprehensive restrictions on exposure to alcohol advertising (across multiple types of media)
Enact and enforce restrictions on the physical availability of retailed alcohol (via reduced hours of sale)

[1] This excludes Kosovo and West Bank and Gaza Strip which are not WHO member states. In addition South Sudan, Somalia, Syrian Arab Republic, and the Democratic People's Republic of Korea have been excluded due to a lack of GDP data available to project prices. Kiribati has been excluded as insufficient baseline epidemiology data was available.

UNHEALTHY DIETS
Reduce salt intake by engaging the industry in a voluntary reformulation process
Reduce salt intake through implementation of front-of-pack labelling
Reduce salt intake through a behaviour change communication mass media campaign
Reduce salt intake through establishment of a supportive environment in public institutions such as hospitals, schools and nursing homes to enable low sodium meals to be provided
PHYSICAL INACTIVITY
Increase physical activity rates through a behaviour change communication mass media campaign
PHARMACEUTICAL CVD INTERVENTIONS
Combination drug therapy post even and for those at 20% or greater risk of CVD event over the coming 10 years
CERVICAL CANCER
HPV vaccine in 13 year old girls
Prevention of cervical cancer through screening and treatment

INTERVENTION IMPACT SIZES

Two alternative scenarios are measured using the OneHealth Tool impact module – the first in which the intervention coverage scales up to the target coverage levels in either a linear fashion from 2018-2030 or applies policy interventions in the year in which they are enacted, and the counterfactual in which the coverage remains 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 CVD events between the two scenarios represents the health gain attributed to additional investment in an intervention.

Table 3: Impact sizes of interventions modelled

Intervention	Effect Size on tobacco prevalence	Comments on evidence
Increase excise taxes and prices on tobacco products	Elasticity is -0.2 to- 0.5[2]	Based on an assumed tax increase that increases the retail price of cigarettes by 25%.
Enact and enforce comprehensive bans on tobacco advertising, promotion and sponsorship	Reduction in prevalence of 10% if implemented at the highest intensity level[3]	
Implement large graphic health warnings on all tobacco packages Additionally, implement plain/standardized packaging	Reduction in prevalence of 4% if graphic health warnings implemented at the highest intensity level[3]	
Eliminate exposure to second-hand tobacco smoke in all indoor workplaces, public places, public transport	Reduction in prevalence of 4% if implemented at the highest intensity level[3]	
Implement effective mass media campaigns that educate the public about the harms of smoking/tobacco use and second hand smoke	Reduction in prevalence of 3.8% if implemented at the highest intensity level[3]	
Reduce salt intake by engaging the industry in a voluntary reformulation process	2.2 g/day salt reduction[4]	Based on Argentina experience
Reduce salt intake through implementation of front-of-pack labelling	1.8g/day salt reduction men 1.0 g/day salt reduction women[5]	The experience in Finland indicated that salt intake reduced by 15% following implementation of a labelling system[5]. This translates to the gram per day reductions indicated.[6]
Reduce salt intake through a behaviour change communication mass media campaign	5% reduction in salt intake per day[7]	Movement from 8.48 to 8.05 g/day via urinary excretion in Vietnam following BCC campaign.[7] The same campaign in Australia saw a

		10% reduction in sodium intake[8]. We have taken the conservative option.
Reduce salt intake through establishment of a supportive environment in public institutions such as hospitals, schools and nursing homes to enable low sodium meals to be provided	7% reduction in salt intake per day	A British study on implementing standards for school meals shows a 30% reduction in sodium intake.[9] An Australian study shows a 20% reduction in sodium intake.[10] We take the more conservative Australian study as the base, along with the assumption that with one out of three daily meals eaten in public places, the overall impact on daily sodium intake would be one third of that observed in the school lunches
Drug therapy (including glycaemic control for diabetes mellitus and control of hypertension using a total risk approach and counselling to individuals who have had a heart attack or stroke and to persons with high risk (≥ 30%) of a fatal and non-fatal cardiovascular event in the next 10 years	-1.05 mmol/L change in cholesterol[11] 5.9mmHg reduction in systolic blood pressure[6]	Intervention impact is mediated via the risk prediction equation[12] Additional supportive evidence suggests a reduction in stroke incidence of 80% and IHD incidence of 88% predicted in use of fixed dose polypill[13]
Treatment of new cases of acute myocardial infarction with acetylsalicylic acid,	acetylsalicylic acid[14] reduction in CVD mortality 15%, ischemic stroke mortality 30%, haemorrhagic stroke mortality 20%	

COVERAGE AND SCALE UP PATTERNS

For the purposes of this analysis, ambitious implementation and coverage scale up patterns were modelled, in order to demonstrate the impact that an increased commitment to NCDs could yield. For all interventions, expert opinion was sought from WHO technical groups related to the quickest possible time in which interventions were believed to be implementable. Table 4 provides a summary of scale up patterns.

Table 4: Intervention Scale Up Summary

Intervention	Scale up time frame
Clinical interventions for cardiovascular disease and cervical cancer	From current to 50% coverage of population in need by 2030
Tobacco "P" – protect people from tobacco smoke	1 year – begin 2019, implement 2020
Tobacco "W" - warnings -- mass media	1 year – begin 2018, implement 2019
-- packaging	3 years – begin 2018, implement 2021

Tobacco "E" – enforcement of bans on advertising	1 year – begin 2019, implement 2020
Tobacco "R" – raise taxes	3 year step-wise pattern to reach 75% of price by 2027-30
Salt "H"– reformulation	3 years to implement, with 28 years to reach full impact potential
Salt "A"– front of pack labelling	3 years to implement, with 28 years to reach full impact potential
Salt "K" – mass media campaigns	1 year – begin 2018, implement 2019
Salt "E" -- low salt food in public spaces	3 years to implement, with 28 years to reach full impact potential
Alcohol – marketing restrictions	2 years, beginning in 2018
Alcohol - taxation	3 year step-wise pattern to reach 50% of price by 2027-30
Alcohol – advertising restrictions	2 years, beginning in 2018
Physical Activity mass media	1-2 years dependent on readiness

CLINICAL INTERVENTIONS

For the clinical interventions – treatment of those at high risk of cardiovascular disease or post event with multidrug therapy and cervical cancer screening and treatment in the absence of country level data collection systems to monitor coverage, and based on expert knowledge, it was assumed that current coverage in low and lower middle income countries is no higher than 5% of needs being met. In order to reach the SDG target of meeting 50% of current unmet need by 2030, we assumed a linear scale up from the current value to 50% coverage in 2030. The assumption that the health system will strengthen and increase capacity in the appropriate way to meet this target is implicit within the analysis, however as the health system must strengthen as a whole, this has not been costed. For understanding of resource needs for health system strengthening, readers should review the SDG health price tag analysis[15]

TOBACCO CONTROL INTERVENTIONS

The intensity of the MPOWER interventions are graded from 1 to 4, with 1 being the lowest and 4 being the highest level of implementation. These grades correspond to the scores in the most recent WHO Report on the Global Tobacco Epidemic (GTCR)[16], with the exception of R (expressed in total tax share), and W-graphic warnings/plain packaging (modified scale that includes plain/standardized packaging at level 5).

We assume a scenario, where the scale-up happens ambitiously, and at the soonest possible time for all countries. However, we also take into consideration what is historically possible, meaning that these immediate scale-ups or *jumps* to the highest level of implementation have been observed before. The baseline figures for these interventions were sourced from GTCR 2017 (2016 data), while scale up was assumed to begin in 2019 – the year after the publication of the NCD business case.

- **For P –** Smoke-free policies **& E –** Tobacco Advertising, Promotion and Sponsorship bans: The consensus was that these are interventions with no specific pattern of scaling up (i.e. a country at level 1 or 2 can just as easily jump to level 4 as those countries in level 3). Also, there is no set time-frame by which these interventions occur. Since these are legislative processes in most countries, the team considered it best to allocate 1 full year for these processes (drafting the law, debates, approval, etc.), before its full implementation can begin. Hence for the ambitious scenario, we assume that 2019 is when the process of changing the policy will begin, with 2020 as the first full year of implementation for all countries at the highest level.
- **For W –** Mass Media: Since this is usually an executive function that mainly requires budgetary allocation to be implemented, the consensus of the team was that it could be scaled up immediately given that funds are available. Because of this, all countries scale up by 2019.
- **For W –** Graphic Warnings / Plain Packaging: Appendix 3 lists these interventions together, however plain packaging is not included in the GTCR score. To resolve this, it was decided that plain packaging be added as an additional level of implementation (level 5). This makes sense because all countries that have implemented plain packaging are already scored at the highest level in GTCR. In addition, the effect size for plain packaging, although separate, can be added into the projection in the OneHealth Tool.

With regards to the scale up pattern, similar to smoke-free policies and TAPS bans, this usually requires some form of legislative approval which means having at least one year allocated for that. Looking at historical data, countries could also jump from having the lowest level of implementation to the highest level. However, the team's expert opinion is that this particular intervention would need a longer time frame to be implemented, considering that the highest level of implementation (for this simulation) is plain packaging. Hence the earliest time for full implementation would be 2021 among countries that aren't already at the highest level.

- **For R –** Taxation: The team considered the data from GTCR and observed that countries below the highest level of implementation (with less than 75% total tax share of retail price) increased their taxes from 2% to 2.5% per year on average. However, once a country has had a significant increase, it would take at least another 3 years before the next significant increase is implemented. This is the main rationale for the 3-year stepwise scale-up pattern, and the corresponding magnitude of 7.5% for each step (2.5% each year).

We are targeting the highest level of implementation for all countries by 2030; therefore the scenario is built so that all countries reach a 75% tax rate by 2028-2030. In order to reach this level, and following the determined scale up pattern of 7.5% every three years, all countries needed to have a tax rate of at least 52.5% by the first step of scaling-up in 2019. This is the reason why countries that had lower tax shares (below 52.5%) have a slightly different pattern. In keeping with the aggressive scale-up, it was decided that the first jump would be to 52.5% for countries below that threshold. Though certainly very ambitious for some countries, the team considered this as a possible scenario given that historical GTCR data shows the maximum tax share jump to be an increase of 48 percentage points, which happened with a country that initially had a 2% tax share. This is also consistent with the observation that a jump of this magnitude is more feasible if coming from a very low starting point, compared to having the same jump from ~30% to 75%. After this first scale-up, it would then revert to the 7.5% increase every three years until it reaches 75% in 2028.

For countries already at the highest level of implementation (above 75%), it was observed that taxes still increased by approximately 1% per year. In keeping with the 3-year pattern, these countries would then increase their tax rates 3% at a time, until their rates have surpassed 80%, after which no additional increases are projected.

ALCOHOL REDUCTION POLICIES

A baseline of coverage was constructed based on the NCD Progress Monitor [17]. The following exclusions and clarifications were made to the NCD Progress Monitor data:

- Following the NCD Progress Monitor, those countries that were marked as ‘n/a’ in the previous NCD Progress Monitor were excluded. This applied to: Bolivia, Haiti, Kyrgyzstan, Micronesia, Nepal, Papua New Guinea, Solomon Islands, and Tunisia.
- ‘Dry’ countries (i.e. those in which alcohol is prohibited) were included, and the policy recorded as in place. This applied to: Afghanistan, Somalia, Sudan and Yemen.

As with the approach taken for the above tobacco control policies, expert input was sought on the quickest feasible scale-up for countries, based on historical precedent.

For legislation based alcohol reduction interventions, i.e. reducing the availability of alcoholic products through reduced hours of sale, and restricting advertising, the following approach was taken:

Based on historical precedent, it was assumed that the fastest a country could implement a policy from not having a policy in place through development of the legislation to the point of implementation would be two years. The same approach has been used for legislation-based tobacco control interventions. This was then ‘scored’, by creating a dual scenario from the baseline 2018 data; i.e. an enforcement score of 1 was given for countries that did not have a policy in place in 2018, and an enforcement score of 2 was given for those that did. For those countries with an enforcement of 1, costing for the planning, development and then full implementation of the policy was applied, with full implementation costs being reached in 2020. For those countries with an enforcement score of 2, the costs of full implementation of the policy were applied from 2018.

For taxation on alcoholic products, the following approach was taken: Baseline data was constructed from the OneHealth Tool, with taxation as a percentage of retail price recorded separately for beer, wine and spirits. A scale- up scenario was then applied, following the tobacco taxation model, in which the tax on all products increases every 3 years, reaching 50% (or above) in 2030. For those countries currently below a level 12.5% tax of retail price, the first increase was to 12.5%, and then 12.5% every three years thereafter, thereby reaching 50% by 2030[1]. For those countries that that already have a taxation level above 50%, the same increase every 3 years was applied, with a ceiling of 200%. These levels of taxation are in keeping with the very wide range of taxation levels for alcoholic products seen across the world.

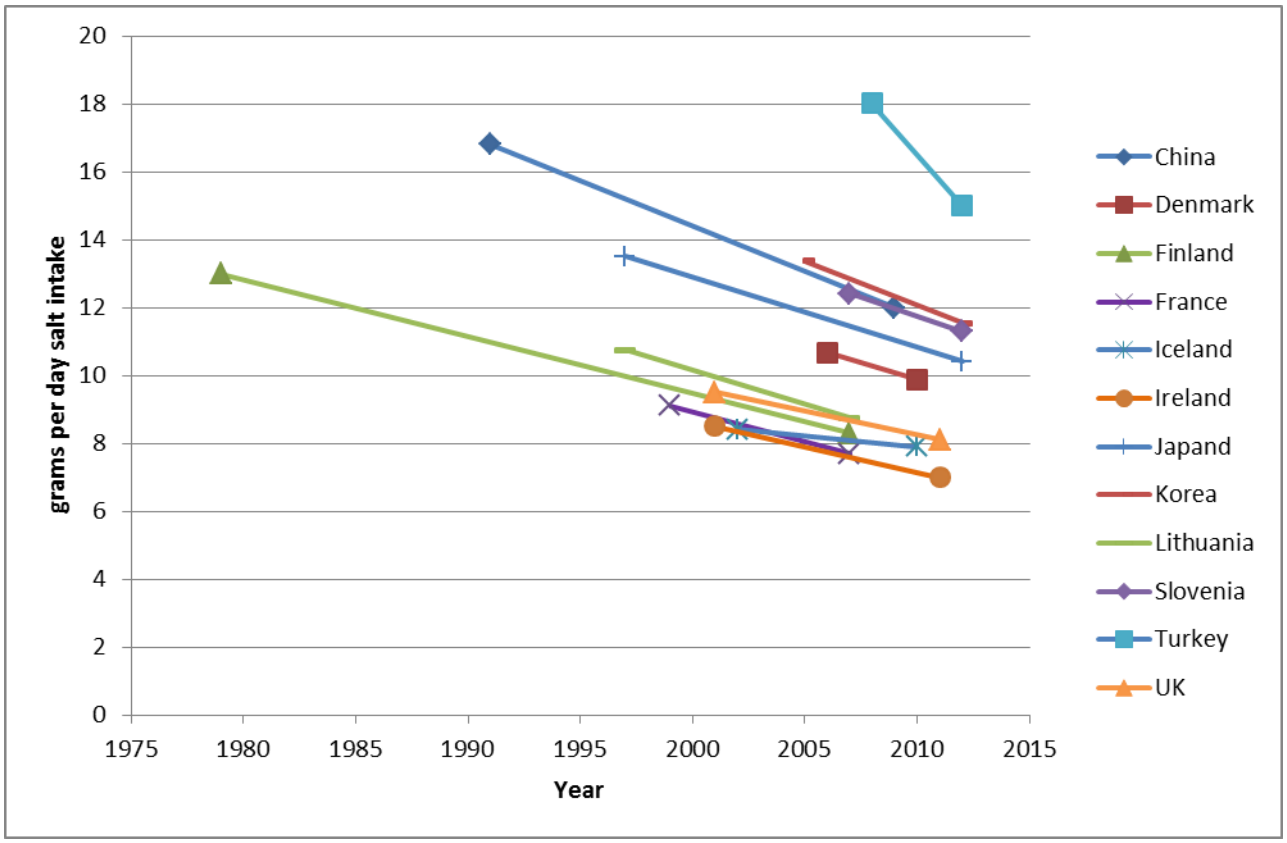
UNHEALTHY DIETS

Limited country experiences exist for the SHAKE package of sodium reduction policies. The first assumption made was that a minimum of 3 years is required in order to create the political economy within which sodium reduction policies can be implemented. The fastest scale up is likely to be in mass media campaigns incorporating behaviour change communication techniques which aim to change population behaviour around adding salt at the table. The other interventions, particularly reformulation processes will require some time not only due to the political economy but also due to the time it will take companies to complete reformulation processes.

Current country implementation was taken from the NCD progress monitor [17]. An assessment was then made by the WHO technical teams about the readiness of countries to implement new policies, and an implementation year ranging from immediate to 2020 was proposed.

In 12 high income countries where packages of salt reduction policies have been implemented over a period of time, the average rate of change seen in salt intake is between 1 and 2% per year[18]. Figure X below shows tracking over time of these countries salt intake. The maximum change seen is in Finland where a reduction in intake of 38% has been observed over a period of 28 years. The combination of 4 salt reduction policies that are best buys have an impact of approximately 40% reduction in salt intake. Therefore we make the assumption that it will take this 28 year time frame to reach full implementation of these interventions. As this purpose of this modelling exercise was to model ambitious scale up patterns, we assume that 50% of the full possible health benefit could be seen by 2030.

Figure 1: historical examples of salt reduction policy impact



PHYSICAL INACTIVITY MASS MEDIA

All countries were assumed to need a lead time of 1-2 years to develop a mass media campaign, followed by an implementation year during which health benefits begin to be seen. Countries existing policies were taken from the NCD Progress Monitor[17] . An assessment was then made by the WHO technical teams about the readiness of countries to implement new policies, and an implementation year ranging from immediate to 2020 was proposed.

THE HEALTH BENEFITS OF SCALING UP INTERVENTION COVERAGE

We use the NCD impact module of the inter-UN agency OneHealth Tool (OHT) to calculate the health benefits of scaling up the best buy interventions. OHT is designed to strengthen health system analysis and costing and to develop financing scenarios at the country level. It is primarily designed to inform the development of national strategic health plans, by assessing parameters related to cost, impact and financing projections related to strengthening health systems and delivering costed and quantifiable strategic plans in low- and middle-income countries. Given its incorporation of epidemiological models that allow for prediction of health outcomes and costs in an integrated way across programmes and interventions, OHT has been used for previous global "investment cases", including Cardiovascular disease[19], reproductive, maternal, newborn and child (RMNCH) health [20] and mental health[21], as well as for the cost and impact analysis for the SDG Health Price Tag [15].

The impact modules developed for cardiovascular disease, diabetes, asthma, COPD and cancers follow the structural format of the population models previously used in WHO's cost-effectiveness programme, WHO-CHOICE [22, 23].These are multi-state dynamic population life tables, taking account of competing risks amongst diseases, causes of death and interventions. The impact modules are populated at the regional level using the 21 Global Burden of Disease (GBD) regions, further analysed to develop complete epidemiological models. Data to populate the modules is derived from the 2010 GBD study along with the WHO Global Health Estimates database, and supplemented by literature reviews where data were missing. Consistent disease input data is estimated using the DisMod 2 programme [24] before being entered into the Spectrum platform. Risk factor modules impact the incidence of associated diseases using relative risks from the Global Burden of Disease Comparative Risk Assessment analysis[25]. Country-specific current risk factor prevalence was drawn from WHO Global Health Database, except for salt intake which was taken from the Global Burden of Disease estimates.[26] A full list of epidemiological parameters used to populate the modules is available online at http://www.avenirhealth.org/software-onehealth.php , and is summarized in table 5. Note that the modelling platform for NCDs has a current baseline year of 2010 for all disease explicitly modelled. Data are projected from 2010 through to the base year of this projection (2018), and thereafter through to the final year 2030. United Nations World Population Prospects [27], including future predicted trends in mortality and population size, are incorporated into the underlying demographic module, DemProj.

Table 5 Parameterization of the OneHealth Tool

Data input	Measured as	Source
Tobacco smoking	Yes/No	WHO GHDx (Country specific data for ages 20+ M/F)[28]
Alcohol intake	Hazardous and harmful use	WHO GHDx (Country specific data for ages 20+ M/F)[28]
Physical activity	Insufficient vs sufficient	WHO GHDx (Country specific data for ages 20+ M/F)[28]
Salt intake	Grams per day	Global Burden of Disease estimates [26]
BMI	BMI (kg/m^2)	WHO GHDx (Country specific data for ages 20+ M/F) [28]
Systolic Blood Pressure	mmHg (population mean and SD)	WHO GHDx (Country specific data for ages 25+ M/F) [28]
Cholesterol	mmol/L (population mean and SD)	WHO GHDx (Country specific data for ages 25+ M/F) [28]
Stroke epidemiology	Prevalence	IHME GBD data[29]

	Mortality	RR mortality post stroke, adjusted by regional variations in stroke deaths[30, 31]
	Incidence	DisMod 2 calculation using prevalence and mortality inputs[24]
IHD epidemiology	Prevalence	IHME GBD data[29]
	Mortality	RR mortality post IHD, adjusted by regional variations in IHD deaths [32, 33]
	Incidence	DisMod 2 calculation using prevalence and mortality inputs[24]
Diabetes epidemiology	Prevalence	IHME GBD data[29]
	Mortality	RR mortality from Asia Pacific Cohort Studies Collaboration[34, 35]
	Incidence	DisMod 2 calculation using prevalence and mortality inputs[24]
Asthma epidemiology	Prevalence	IHME GBD data[29]
	Mortality	Mortality rate from GHE 2010[28]
	Incidence	DisMod 2 calculation using prevalence and mortality inputs[24]
COPD epidemiology	Prevalence	IHME GBD data[29]
	Mortality	Mortality rate from GHE 2010[28]
	Incidence	DisMod 2 calculation using prevalence and mortality inputs[24]
Cervical Cancer epidemiology	Prevalence	IARC Globocan database[36]
	Mortality	IARC Globocan database[36]
	Incidence	IARC Globocan database[36]

The impact modules are used to project two scenarios, one in which current intervention coverage is continued, and an alternative in which the intervention is scaled up at the rate as previously described, and with the health impact previously described. The difference between incidence and mortality rates, and healthy life years lived; between the two populations is the impact of the intervention.

The “Lives Saved” outcome is calculated as the number of deaths which are projected to occur in 2030 if current intervention implementation levels continue, compared to the number of deaths that are projected to occur in 2030 with the intervention scale-up patterns shown earlier.

ESTIMATING HEALTH CARE COSTS OF INTERVENTIONS

The use of the OneHealth Tool to estimate the health costs for individual level interventions enables us to take an integrated approach to costs and benefits. 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 which 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, combined with the WHO-CHOICE price databases [37, 38]. The quantity assumptions used reflect current guidelines for intervention delivery and not necessarily delivery practices in countries. Estimates of the number of health services delivered by country and year enable calculation of the additional health systems capacity to deliver the interventions at scale. For the non-commodity intervention specific costs, the number of inpatient and outpatient visits is calculated in the OHT and then multiplied by the WHO-CHOICE unit prices for inpatient and outpatient visits[39]. Table 6 and 7 outline costing assumptions for policy/population wide interventions and individual pharmaceutical interventions, respectively.

Table 6: Costing inputs for policy/population wide interventions

Intervention	Major costing assumptions
Increase excise taxes and prices on tobacco products	Taxation is considered a legislative intervention. Assumptions on human resource requirements are previously published[40]
Enact and enforce comprehensive bans on tobacco advertising, promotion and sponsorship	This is considered a legislative intervention. Assumptions on human resource requirements are previously published[40]
Implement large graphic health warnings on all tobacco packages Additionally, implement plain/standardized packaging	This is considered a legislative intervention. Assumptions on human resource requirements are previously published[40] It is assumed that plain packaging would require additional legislation to large graphic health warnings.
Eliminate exposure to second-hand tobacco smoke in all indoor workplaces, public places, public transport	This is considered a legislative intervention. Assumptions on human resource requirements are previously published[40]
Implement effective mass media campaigns that educate the public about the harms of smoking/tobacco use and second hand smoke	Generic advocacy/awareness campaigns are included as part of all health care interventions, with assumptions relying on information from the marketing literature. We estimated that 10 times the intensity would be required to enact behaviour change in line with previous costing estimates[40]
Reduce salt intake by engaging the industry in a voluntary reformulation process	Voluntary intervention assumptions are published in previous work on the costs of scaling up NCD action[40]
Reduce salt intake through implementation of front-of-pack labelling	Legislative intervention assumptions are published in previous work on the costs of scaling up NCD action[40]
Reduce salt intake through a behaviour change communication mass media campaign	Behaviour Change communication is considered as an intensive mass media campaign. Costs have been developed based on literature reviews across public health and marketing to ensure adequate viewership is reached

Reduce salt intake through establishment of a supportive environment in public institutions such as hospitals, schools and nursing homes to enable low sodium meals to be provided	Legislative intervention assumptions are published in previous work on the costs of scaling up NCD action[40]
Increase in excise taxes on alcoholic beverages	Key categories of resource include human resources (e.g. administrators, lawyers), training (e.g. enforcement), meetings, mass media. Assumptions follow previous work on the costs of scaling up NCD action[40]
Enforcement of bans or comprehensive restrictions on exposure to alcohol advertising, promotion and sponsorship (across multiple types of media)	Key categories of resource include human resources (e.g. administrators, lawyers), training, meetings, mass media. Assumptions follow previous work on the costs of scaling up NCD action[40]
Enforcement of restrictions on the physical availability of retailed alcohol (via reduced density of retail outlets and reduced hours of sale	Key categories of resource include human resources (e.g. administrators, lawyers), training, meetings, mass media. Assumptions follow previous work on the costs of scaling up NCD action[40]
Implement community wide public education and awareness campaign for physical activity which includes a mass media campaign combined with other community based education, motivational and environmental programs aimed at supporting behavioural change of physical activity levels.	Behaviour Change communication is considered as an intensive mass media campaign. Costs have been developed based on literature reviews across public health and marketing to ensure adequate viewership is reached. The price was benchmarked against a successful BCC campaign for physical activity in Australia [41]

Table 7: Costing assumptions for pharmaceutical interventions

	Percent receiving	Number of units/day	Days per case	Unit cost (USD) (2018)	Cost per case (USD) (2018)
Combination drug therapy for those post event or at 20% or greater risk.					
Drugs and supplies required per patient					
Hydrochlorothiazide, tablet, 25 mg	95	1	365	0.0043	1.491025
Enalapril, tablet, 20 mg	40	1	365	0.01	1.46
Atenolol, tablets, 50 mg	25	1.5	365	0.01	1.36875
Amlodipine, tablet, 10 mg	40	0.5	365	0.08	5.84
Simvastatin, 15 mg	100	1	365	0.04	14.6
Laboratory tests per patient					

Blood glucose level test	30	1	1	2	0.6
Cholesterol test	30	1	1	2	0.6
Urine analysis	30	1	1	1.83	0.549
Urine sugar analysis	100	1	1	0.67	0.67
Facility visits per patient					
Outpatient	3 per year	97% of patients			
	7 per year	3% of patients			

The model calculates total costs for intervention implementation for each country. The sum of country level costs are then divided by the sum of the population from the countries in each income level to provide an average per capita cost for each income level. Costs are stratified by low income, lower-middle income and total costs.

ESTIMATING THE ECONOMIC AND SOCIAL RETURNS ON INVESTMENT

TRANSLATING AVOIDED DEATHS INTO ECONOMIC RETURNS

The economic modelling of mortality follows the cohort of avoided deaths for each of the years 2018 to 2030. Each cohort is classified by age and sex. The effect of avoided mortality on the labour force is calculated by taking the numbers of deaths avoided by age and sex and applying a corresponding labour force participation rate for this age, sex and year sourced from country specific International Labour Organization projections of labour force participation rates [42].

The contribution that each of these labour force cohorts makes to economic output is calculated by multiplying the number in each age and sex category who participate in the workforce by a value of the GDP contribution per worker. To do this the average productivity is first calculated for 2018 by dividing the World Bank estimate of GDP in current US dollars by the labour force in that year. The total GDP generated is calculated by summing the GDP produced by each cohort for each year of the period in which they are in the labour force.

TRANSLATING INCIDENT CASES AVOIDED INTO ECONOMIC RETURNS

The contribution to GDP of each cohort of healthy persons is calculated in a similar way as for mortality using the same assumptions about participation rates and productivity in the cohort of avoided incident cases of CVD. Firstly, 11% of people who have a heart attack or stroke will leave the work force entirely. Those who avoid having an event will continue to participate in the workforce, this contribute the GDP per worker value each year. It is assumed that there is reduction in productivity of 0.5% due to absenteeism[43] (those who miss work days) and 3.7% due to presenteeism[44] (those who attend work but are less productive than expected) for those with CVD who continue to work. These values are similar to those reported by Alsono et al [45]and Bruffaerts et al [46] based on analysis of the World Mental Health Surveys. Again, the differential contribution to GDP from each cohort is summed to give a total contribution to GDP for each year.

SOCIAL BENEFITS OF INCREASED YEARS OF HEALTHY LIFE

It is common when estimating the benefits of improved health to put a value on being alive. The common term employed for this kind of statistic is the *value of statistical life* (VSL), but a more accurate term would be the *value of* (a small) *risk reduction* (VRR). Building on the results of Viscusi et al [47], Jamison et al [48] , estimated the value of a life year as between 1.4 and 4.2 times GDP per capita, averaging 1.6 globally. Stenberg et al [20] modified this approach by assuming that the value of a life year was 1.5 times GDP per capita and that the economic benefit was equal to GDP per capita, leaving a residual value of 0.5 times GDP per capita as the social benefit. Following this approach, we apply a value of 0.5 times GDP per capita to each healthy life year gained from the interventions to estimate the intrinsic value of longevity. An exception to this within our methodology is for cervical cancer where we were not able to capture incident cases avoided, and instead used a VSL of 1.5 times GDP per capita for each life year saved due to premature mortality avoided.

CALCULATING THE RETURN ON INVESTMENT

While the returns to an investment in health can be expressed using different but related metrics such as the internal rate of return, this paper uses benefit-cost ratios (BCR) to compare net present values of benefits and costs. These ratios were calculated by dividing the net present value (NPV) of the economic and social benefits from mortality and morbidity avoided by the net present value of the costs of the intervention. NPVs were calculated at a discount rate of 3% as is usual for analysis of health programs.

SUMMARY OF FINDINGS

COSTS OF SCALING UP ACTION

Lack of political prioritisation and action for non-communicable disease (NCD) prevention and control places the world at risk of failing to meet the SDG targets if action is not swift and ambitious. The NCD "best buy" interventions suggest high-priority, low cost interventions that can be implemented in all settings if political will can enable it. To rapidly implement all policy-level "best-buys", and begin a concerted effort to scale up individual level "best-buys" to reach 50% coverage by 2030 will cost just $0.62 per capita in low income countries and $1.44 per capita in middle income countries – an average of just $1.27 per person, per country, per year (table 8). The majority of costs are for clinical services, with population level costs of policy interventions very low on a per capita basis (figure 2).

Table 8: Investment needs for best-buys

		Investments needed				
	Policy	Cost of implementation				
		Total cumulative to 2030, $ millions	Total cumulative to 2023, $ millions	Total per capita average 2018-2023	Total per capita average 2024-2029	Total per capita max 2030
Best-buys sub package	Total package of all 16 best-buys	$45,296	$12,954	$0.55	$1.01	$1.27
	Reduce Tobacco Use	$2,485	$1,152	$0.05	$0.04	$0.04
	Reduce the harmful use of alcohol	$3,163	$1,495	$0.06	$0.05	$0.06
	Reduce Unhealthy Diets	$2,390	$1,256	$0.05	$0.04	$0.03
	Reduce Physical Inactivity	$159	$56	$0.00	$0.00	$0.00
	Pharmaceutical management of CVD	$32,109	$7,825	$0.33	$0.75	$1.00
	Management of Cancer	$5,424	$1,360	$0.06	$0.13	$0.14

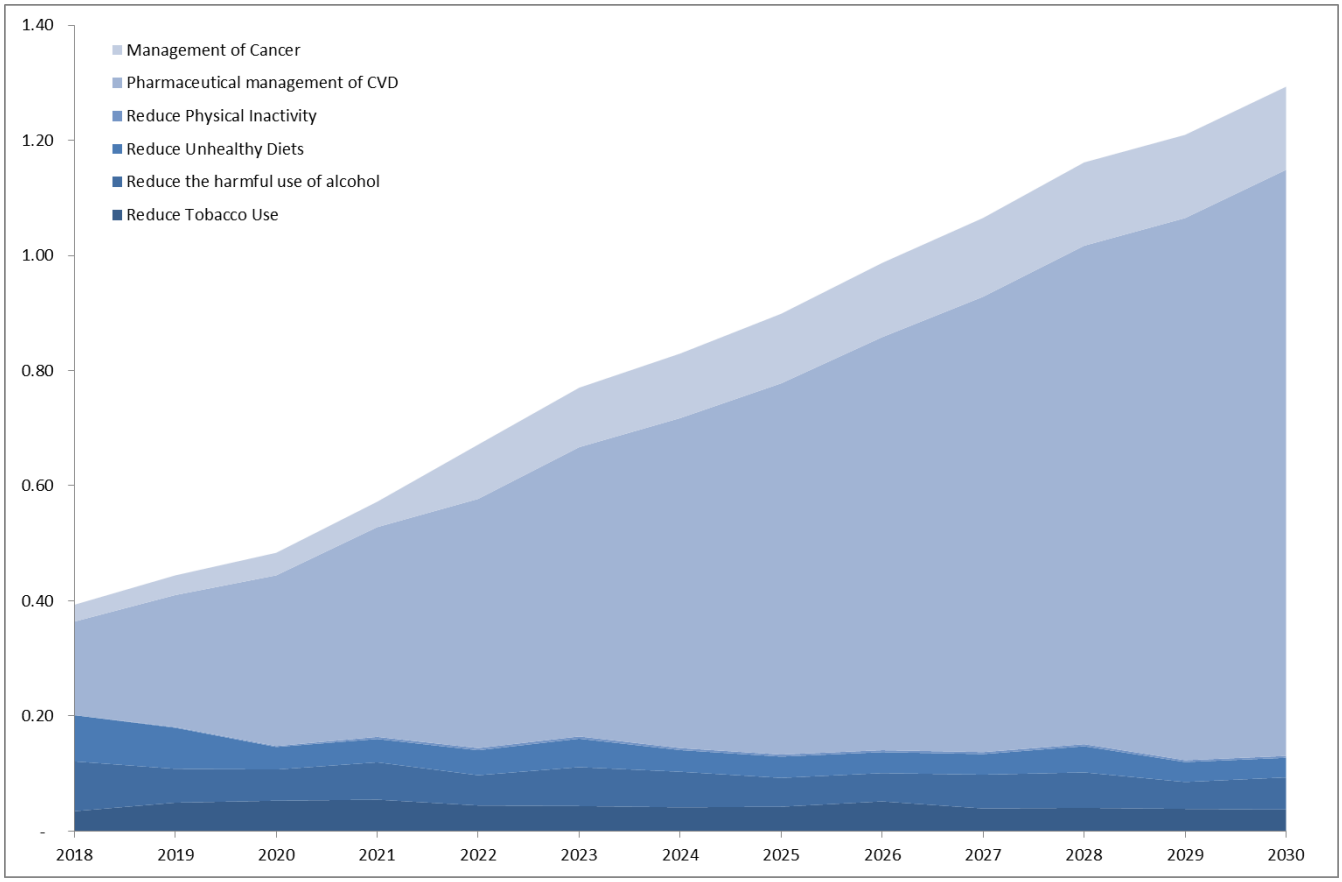


Figure 2: Investment needs by intervention sub-package

HEALTH BENEFITS

Current rates of non-communicable diseases are responsible for approximately 8.5 million premature deaths per year in low and lower middle income countries, with cardiovascular disease responsible for approximately 40% of these deaths, and cancer 27%. Implementing the best-buy interventions would prevent 8.1 million premature deaths by 2030 (table 7). This represents a reduction of almost 15% in total premature mortality due to NCDs, however when looking at CVD alone – which is the major health outcome of many of the best buys – the SDG target would be reached by 2028, and surpassed by 2030. Additional targeted interventions for cancer control and other NCD treatment are also needed to fully achieve the SDG target (Figure 3).

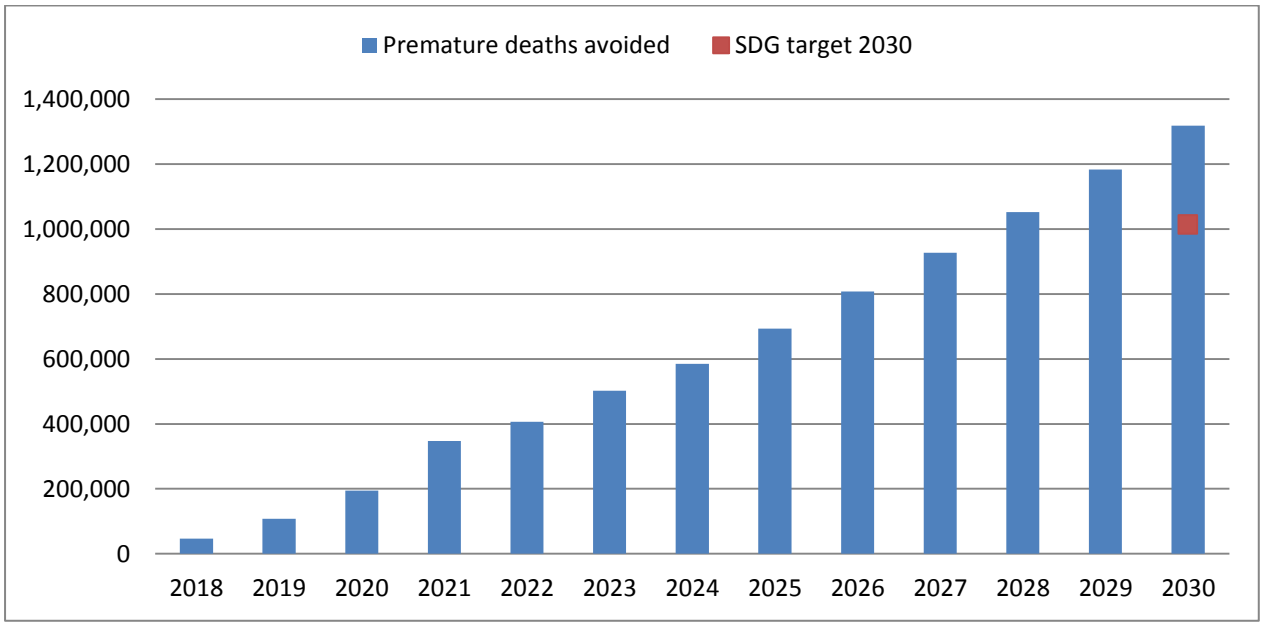


Figure 3: Deaths avoided and SDG target for CVD mortality

In addition to mortality prevention, these interventions will prevent many primary events from occurring, as many as 17 million stroke and ischemic heart disease events by 2030 (table 9). Consequently people will live longer, happier, healthier lives, with 72 million additional healthy life years lived.

Table 9: Health impact associated with scaling up best-buys

	Policy	Lives saved		Healthy Life Years Gained		IHD + Stroke Cases Avoided	
		Total lives saved, cumulative 2018 - 2023	Total lives saved, cumulative 2018 - 2030	Total HLY, cumulative 2018 - 2023	Total HLY cumulative 2018 - 2030	Total cases avoided, cumulative 2018 - 2023	Total cases avoided, cumulative 2018 - 2030
Best-buys sub package	Total package of all 16 best-buys	1,544,681	8,171,626	11,780,877	81,503,254	5,534,863	17,207,993
	Reduce Tobacco Use	56,928	352,275	1,216,542	8,364,550	280,536	906,897
	Reduce the harmful use of alcohol	14,217	96,863	5,550,391	32,082,596	9,901	56,034
	Reduce Unhealthy Diets	64,656	1,196,934	537,312	11,231,040	266,438	2,668,144
	Reduce Physical Inactivity	1,218	10,173	11,584	110,831	8,043	29,628
	Pharmaceutical management of CVD	1,147,735	5,560,231	2,607,893	20,593,805	839,478	3,938,440
	Management of Cancer	140,047	670,346	-	-	-	-

THE ECONOMIC BENEFITS OF INVESTMENT

Investing in NCD prevention and control has not only health but economic benefits. People without NCDs work more days per year and work more productively. Preventing deaths from NCDs increases the volume of the workforce, also contributing to economic growth. Investing in the NCD best buys yields a return of at least $7 for every $1 invested by 2030. The economic benefits amount to $2.05 per person, per year on average by 2023, growing to an average of $9.03 per person per year between 2023 and 2029, and peaking $14.06 per person per year in 2030.

RETURN ON INVESTMENT

When considering that many of these interventions are preventive, and the full impact will be seen over a generation, this is a strong return over only 12 years (table 10). The highest return on investment is seen for investment in sodium reduction policies, which have a large health impact for a very low average cost.

Table 10 : Economic benefits of best buys implementation

	Policy	Low income countries	Lower-middle income countries	Overall
Best-buys sub package	Total package of all 16 best-buys	$ 2.05	$ 8.01	$ 7.43
	Reduce Tobacco Use[2]	$ 5.01	$ 7.98	$ 7.63
	Reduce the harmful use of alcohol	$ 3.45	$ 9.51	$ 9.13
	Reduce Unhealthy Diets	$ 5.61	$ 13.61	$ 12.82
	Reduce Physical Inactivity	$ 0.72	$ 3.28	$ 2.80
	Pharmaceutical management of CVD	$ 1.14	$ 3.54	$ 3.29
	Management of Cancer	$ 2.25	$ 2.76	$ 2.74

Due to the nature of these preventive interventions there is a differential timing between the costing and health and economic benefits. As demonstrated in figure 4 below, the economic benefits steadily rise over this 12 year period, not yet reaching the plateau.

[2] Note that the impact of tobacco use on lung cancer is not included in the model, thus this should be considered as a minimum ROI

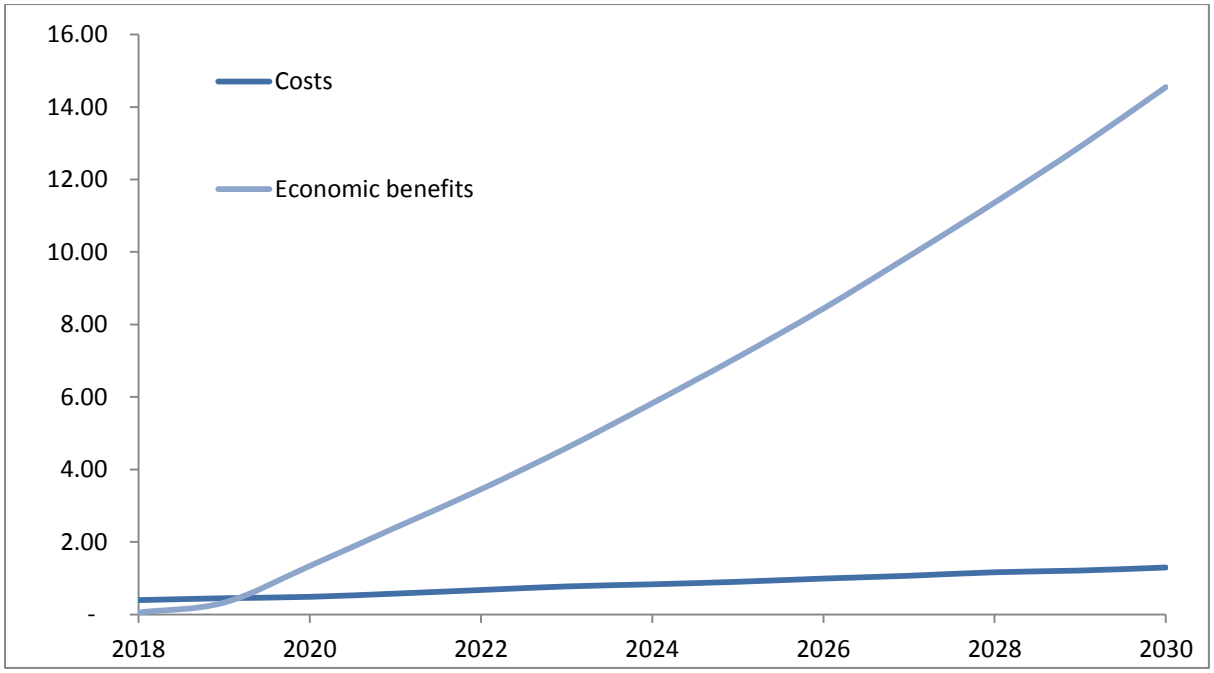


Figure 4: costs and economic benefits of the best-buy strategy

LIMITATIONS OF ANALYTICAL FRAMEWORK

This modelling exercise should necessarily be considered normative and indicative at the global level. In order to fully grasp the costs and health benefits of scaling up action in countries, a country contextualisation process should be undertaken. The model used to underlie this analysis, the OneHealth Tool, is available free to download and use for countries to undertake this process. A contextualisation process involves reviewing the epidemiology taken from global databases (WHO, GBD) and comparing to local sources, identifying how interventions are delivered in countries and if these match the quantity assumptions used in this model, identifying how much is paid for different inputs into the interventions in the local setting – this may differ from global modelled databases – and using the countries' realistic implementation plans.

There are two main limitations which impact ROI values calculated within this analysis. Firstly, we are limited in the number of diseases for which we can prospectively model health impacts. This affects in particular tobacco, where cancers have not been modelled, however given the lag time between smoking cessation and reduction in cancer incidence this is unlikely to influence the ROI greatly over the 12 year period. This brings us to the second limitation which is the time frame through to 2030, the SDG target year. For many of the preventive interventions the full health benefit will not yet be realised. An excellent example of this is physical activity mass media campaigns. If extending the analysis through even 10 additional years, the health benefits increase by 2.5 times, which strongly influences the ROI.

Further limitations related to the ROI calculation are associated with the use of the labor force participation rates from the ILO, which capture only the formal workforce. At the country level more may be known about the informal labour market in order to incorporate this into the analysis. Secondly, relying on GDP per capita and GDP per worker estimates necessarily produces lower economic benefits in countries of lower income. This leads to a correlation between income level and ROI in this type of analysis. This should not be interpreted as indicating that only higher income counties should invest in NCDs. As countries' GDP increases over the coming years, higher productivity values will be seen in those countries currently classified as low income countries. Finally, the use of non-country-specific values for absenteeism and presenteeism has an unknown impact; however, the values used are quite low and we would thus anticipate represent a conservative approach.

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