Global health 2050: High-priority interventions to achieve a grand convergence in premature mortality

Background paper for the Lancet Commission on Investing in Health

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Introduction

In 2013, the Lancet Commission on Investing in Health released its report, "Global Health 2035: a world converging within a generation" (hereafter, "GH2035").[1] The GH2035 report laid out an ambitious and optimistic vision for global health in the coming decades, including the possibility of a "grand convergence" in mortality related to infections and maternal health. By this the report meant that all countries could, by 2035, achieve child, maternal, HIV, and TB mortality rates that had already been achieved in high-performing upper-middle-income countries, thereby reducing global inequalities in health. GH2035 also advocated for an approach to universal health coverage (UHC) called "progressive universalism," i.e., the notion that achievement of UHC should be based on progressive expansion of a limited set of interventions that are offered to all (i.e., high population coverage) and at very low out-of-pocket cost (i.e., with financial protection).

GH2035 was influential within the global health community and laid the foundation for several of the Sustainable Development Goal (SDG) health targets.[2] However, the years following the adoption of the SDGs have seen massive changes. The decline of internationalism and austerity measures have led to a flattening in development assistance after a decade of rapid growth.[3] The Covid-19 pandemic reversed years of health system progress in many low- and middle-income countries.[4] The macroeconomic and fiscal outlook for these countries has become relatively unfavorable,[5] and health has been de-prioritized within government budgets, especially in lower-middle-income countries that have experienced rapid economic growth.[3] Conflict and war are on the rise in several parts of the world, creating further political distractions from health and potential for "health shocks" from injuries and mental trauma.

The challenge for health policymakers in the coming years will be to "do more with less." To this end, the Commission on Investing in Health is preparing a follow-up report that will include guidance for how countries can focus their health agendas on a small set of priority health conditions and interventions. This focused approach is intended to respond directly to the observation that progress on UHC has been very limited, and for many countries achieving UHC is still a long way off.[6] But, as the Commission will say, countries need not wait on UHC to achieve better health for their populations. Additionally, the Commission is extending its recommendations from 2035 for infectious and maternal health conditions to 2050 (for premature death from all causes), underscoring the increasing urgency of tackling noncommunicable diseases and injuries.

To this end, this background paper has been drafted to provide evidence in support of the Commission's main messages around the need to focus the health agenda. Our team is developing a mathematical modeling tool called the FairChoices – Disease Control Priorities Analytics Tool (hereafter, "FairChoices") to support local decision-making around UHC health benefits packages. The methods for the FairChoices tool around intervention cost and impact modeling have not been previously published but are summarized below.

In this iteration of the analysis for the background paper (28 June 2024), we present preliminary estimates of the incremental cost of 92 interventions that are organized into health system "modules." These estimates are featured in the main Commission report that is being published by the Lancet. While the methods below describe the entire FairChoices model, including both costs and effects, the effectiveness inputs are still being validated as of this writing and are not featured in the preliminary results. Another iteration of this background paper that includes updated costs and modeled effects on premature mortality will be submitted in the near future as a separate peer-reviewed manuscript.

Methods

Overview of the FairChoices Model

FairChoices is a deterministic mathematical model of the population that includes demographic and epidemiological parameters taken from international data sources (e.g., Global Burden of Disease 2019 Study,[7] World Population Prospects 2022 Revision[8]). The model calculates the potential impact of interventions by changing rates of disability and mortality from various causes as a function of the effectiveness of the interventions (taken from the literature) and changes in population coverage (e.g., scaling up intervention X from 30% coverage in 2019 to 80% coverage in 2050).

Intervention costs are taken from the literature and adjusted to different country settings. The demographic and epidemiological data identify the population in need of each intervention, which along with the coverage assumptions informs the estimates of aggregate costs. Figure 1 is a schematic of the model for "version 3" of the tool, which will be released publicly in late 2024

following the validation process that is currently underway. Of note, the tool will include an online user interface, shown in the upper right corner, that will be focused on guiding health benefits package design with an emphasis on intervention cost-effectiveness. The analyses presented in this paper were done using the "back end" costing model.

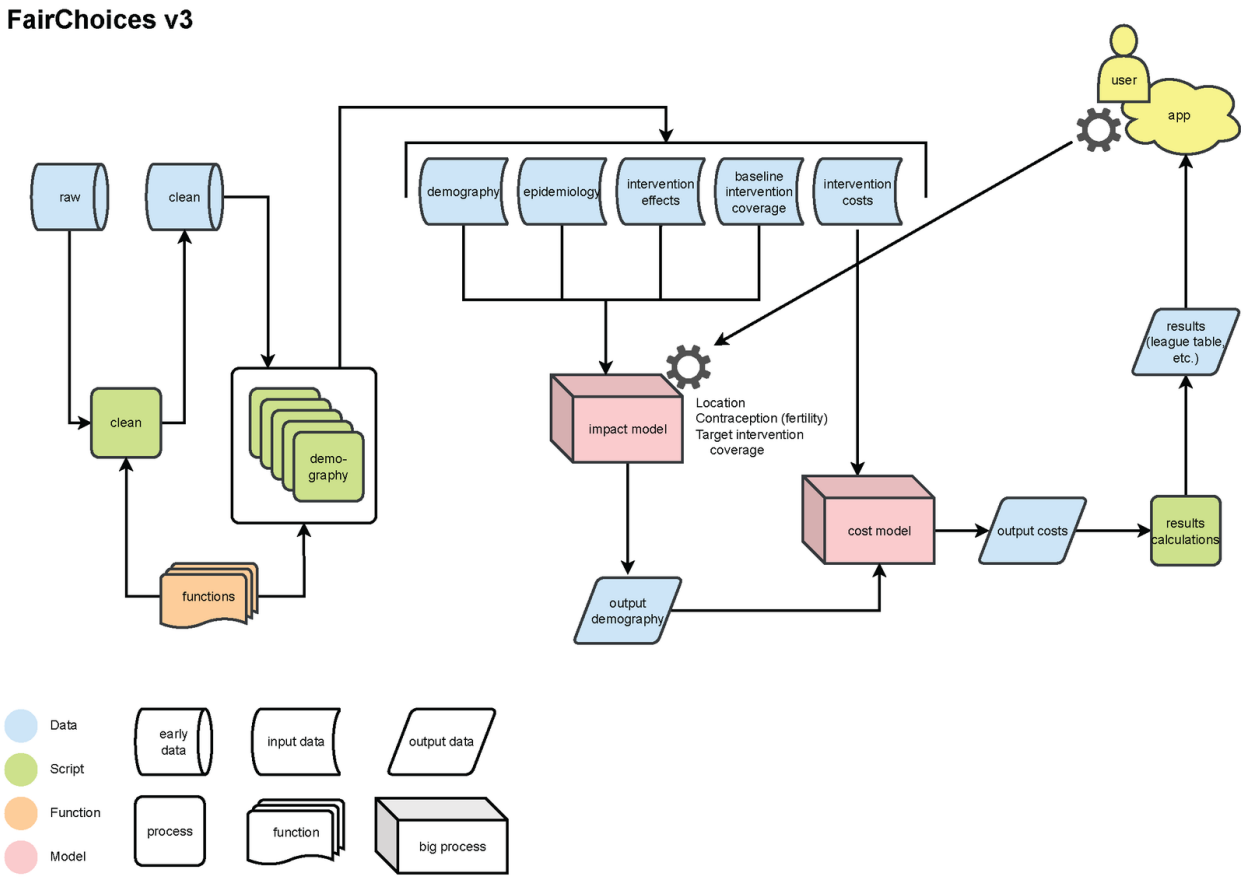

Figure 1. Overview of the FairChoices model

Selection of interventions

The starting point for our list of interventions in FairChoices version 3 is the list of 218 essential health sector interventions featured in DCP3 (published in 2018).[9] We updated the list of interventions with some elements that were missing from DCP3, e.g., management of enteric and lower respiratory infections in adults (as a complement to the DCP3 interventions for children). We also restructured the intervention list around a "taxonomy" that was aligned with the structure of the WHO UHC Compendium (https://www.who.int/universal-health-coverage/compendium/architecture-of-clinical-services).

For this analysis, we selected 92 interventions that address (i) one or more of the 8 "infectious and maternal health conditions" (previously called "grand convergence conditions") in GH2050, (ii) one or more of the 7 "noncommunicable disease- (NCD) and injury-related conditions" in

GH2050, or other health needs that pose major demands on health systems even though they are not major contributors to premature mortality, such as family planning and dental care. For the next iteration of this background paper, we plan to include a range of additional interventions that we are currently validating, especially for NCDs and injuries.

Health impact model

The FairChoices model uses a lifetime perspective on health. This is to capture benefits that last well beyond the implementation period from interventions like HPV vaccination of adolescents, kidney transplant, and obstetric fistula surgery. We do this using a model based on standard lifetable methodology, where input on demography and epidemiology is based on the World Population Prospects and the Global Burden of Diseases and Injuries study (GBD), input on the coverage and effects of the interventions is compiled from the medical literature and other data sources (e.g., WHO Global Health Observatory, World Bank Open Data).

Conceptually, we first assume that without implementing interventions, cause-, sex-, and age-specific mortality and morbidity will remain unchanged into the future. Then we calculate healthy life-expectancy for each cohort (i.e., the people born the same year) alive today and for the cohorts that will be born during the scale-up period.

Assuming a scale-up period of 25 years and that mortality is 100% at age 100, we then need to consider 126 cohorts (C_0 through C_{100} are the cohorts that are alive today, and C_{-1} through C_{-25} the cohorts that will be born the next 25 years). We can now present the mortality of these cohorts as follows:

		Age						
		0	1	2	⋯	98	99	100
Cohort	C_{-25}	M_0	M_1	M_2	⋯	M_{98}	M_{99}	1
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{-1}	M_0	M_1	M_2	⋯	M_{98}	M_{99}	1
	C_0	M_0	M_1	M_2	⋯	M_{98}	M_{99}	1
	C_1	⋯	M_1	M_2	⋯	M_{98}	M_{99}	1
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{99}	⋯	⋯	⋯	⋯	⋯	M_{99}	1
	C_{100}	⋯	⋯	⋯	⋯	⋯	⋯	1

M_x denotes the mortality from age x to age x+1. As seen, $M_{100} = 1$ for all cohorts.
C_y denotes the cohort. A negative y is used if the cohort has not yet been born. C_{-25} denotes the cohort that will be born in 25 years.

One table is constructed for each sex.

Corresponding tables are also constructed for disability (i.e., morbidity), based on the age- and sex-specific disability weights provided by GBD:

		Age						
		0	1	2	⋯	98	99	100
Cohort	C_{-25}	D_0	D_1	D_2	⋯	D_{98}	D_{99}	D_{100}
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{-1}	D_0	D_1	D_2	⋯	D_{98}	D_{99}	D_{100}
	C_0	D_0	D_1	D_2	⋯	D_{98}	D_{99}	D_{100}
	C_1	⋯	D_1	D_2	⋯	D_{98}	D_{99}	D_{100}
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{99}	⋯	⋯	⋯	⋯	⋯	D_{99}	D_{100}
	C_{100}	⋯	⋯	⋯	⋯	⋯	⋯	D_{100}

D_{x} denotes the disability from age x to age x+1. Note that D_{100} is not 1.
C_{y} denotes the cohort. A negative y is used if the cohort has not yet been born. For example, C_{-25} denotes the cohort that will be born in 25 years.

Once these matrices have been population, we introduce interventions that are specified to act on a condition (defined as one of the GBD causes of death or disability) within a sex- and age-specific population and have a duration where they are effective. For treatment of acute conditions, the duration is one year, whereas for interventions like vaccines and obstetric fistula surgery the duration is longer and may even be lifelong.

Each intervention reduces mortality, disability, incidence, or prevalence of one or more conditions. The crude effect of the intervention, $\mathrm{e}_{\mathrm{crude}}$, is adjusted to account for the change in coverage during the scale-up period and the fact that the observed mortality or disability is being experienced mostly among those who are not currently covered by the intervention (though this also depends on how effective the intervention is among those who are covered). We thus use the formula

$$\mathrm{e}_{\mathrm{adj}} = \mathrm{e}_{\mathrm{crude}} \times \frac{\mathrm{cov}_{\mathrm{target}} - \mathrm{cov}_{\mathrm{baseline}}}{1 - \mathrm{e}_{\mathrm{crude}} \times \mathrm{cov}_{\mathrm{baseline}}}$$

Where$\mathrm{e}_{\mathrm{crude}}$ and $\mathrm{e}_{\mathrm{adj}}$ are expressed as relative risk reductions and $\mathrm{cov}_{\mathrm{baseline}}$ and $\mathrm{cov}_{\mathrm{target}}$ are coverage at baseline and target.[10]

Further, M_{x} can be divided into the cause-specific mortality from the targeted condition and what we call “background mortality”, which is the risk of dying from any other cause:

$$\mathrm{M}_{\mathrm{x}} = \mathrm{M}_{\mathrm{x,background}} + \mathrm{M}_{\mathrm{x,cause}}$$

Applying the intervention, we get

$$\mathrm{M}_{\mathrm{x,adjusted}} = \mathrm{M}_{\mathrm{x,background}} + \mathrm{M}_{\mathrm{x,cause}} \times \left(1 - \mathrm{e}_{\mathrm{adj}}\right)$$

As seen, if $e_{adj} = 1$, cause-specific mortality is reduced to zero in the targeted population. If a total of K interventions target the same condition, we get

$$M_{x,adjusted} = M_{x,background} + M_{x,cause} \times (1 - e_{adj,1}) \times \cdots \times (1 - e_{adj,K})$$

where $e_{adj,k}$ is the effect of the k'th intervention. This ensures that cause-specific mortality cannot be less than 0. We make similar calculations for interventions that reduce disability. We also scale up coverage of the intervention gradually over time. This means that the full effect will not be felt until the last year, so that the age-specific mortalities (and disabilities) in different cohorts (C_{-25} through C_{100}) will be affected differently. Hence, to make intervention-"adjusted" versions of the matrices above, each cell is now both age- and cohort-specific.

For mortality:

		Age						
		0	1	2	⋯	98	99	100
Cohort	C_{-25}	$M_{0,-25}$	$M_{1,-25}$	$M_{2,-25}$	⋯	$M_{98,-25}$	$M_{99,-25}$	1
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{-1}	$M_{0,-1}$	$M_{1,-1}$	$M_{2,-1}$	⋯	$M_{98,-1}$	$M_{99,-1}$	1
	C_0	$M_{0,0}$	$M_{1,0}$	$M_{2,0}$	⋯	$M_{98,0}$	$M_{99,0}$	1
	C_1	⋯	$M_{1,1}$	$M_{2,1}$	⋯	$M_{98,1}$	$M_{99,1}$	1
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{99}	⋯	⋯	⋯	⋯	⋯	$M_{99,99}$	1
	C_{100}	⋯	⋯	⋯	⋯	⋯	⋯	1

$M_{x,y}$ denotes the mortality from age x to age x+1 in cohort y. As seen, $M_{100} = 1$ for all cohorts. C_y denotes the cohort. A negative y is used if the cohort has not yet been born. C_{-25} denotes the cohort that will be born in 25 years.

For disability:

		Age						
		0	1	2	⋯	98	99	100
Cohort	C_{-25}	$D_{0,-25}$	$D_{1,-25}$	$D_{2,-25}$	⋯	$D_{98,-25}$	$D_{99,-25}$	$D_{100,-25}$
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{-1}	$D_{0,-1}$	$D_{1,-1}$	$D_{2,-1}$	⋯	$D_{98,-1}$	$D_{99,-1}$	$D_{100,-1}$
	C_0	$D_{0,-0}$	$D_{1,-0}$	$D_{2,-0}$	⋯	$D_{98,-0}$	$D_{99,-0}$	$D_{100,-0}$
	C_1	⋯	$D_{1,1}$	$D_{2,1}$	⋯	$D_{98,1}$	$D_{99,1}$	$D_{100,1}$
	⋯	⋯	⋯	⋯	⋯	⋯	⋯	⋯
	C_{99}	⋯	⋯	⋯	⋯	⋯	$D_{99,99}$	D_{100}
	C_{100}	⋯	⋯	⋯	⋯	⋯	⋯	D_{100}

$D_{x,y}$ denotes the disability from age x to age x+1 in cohort y. Note that D_{100} is not 1.
C_y denotes the cohort. A negative y is used if the cohort has not yet been born. For example, C_{-25} denotes the cohort that will be born in 25 years.

The statistical lives saved (SLS) for the individuals in cohort y is given as

$$\mathrm{SLS_y} = \mathrm{N_y} \times \sum_{\mathrm{x}=0}^{100} \left(\mathrm{M_x} - \mathrm{M_{x,y}}\right)$$

where M_x and $M_{x,y}$ are from the baseline and adjusted matrices, multiplied by respective population counts. If we want to limit ourselves to counting SLS, for example, during the scale-up period, this is done by changing the start and end values of the index x.

Summing over y gives the total SLS

$$\text{Total SLS} = \sum_{y=-25}^{100} \mathrm{SLS_y}$$

Calculating lives saved under a certain age, X, we can first calculate the risk of dying before X for each cohort. At baseline, this risk is

$$\mathrm{P_y(X|baseline)} = 1 - \left(1 - M_{\max(y,0)}\right) \times \cdots \times \left(1 - M_{\mathrm{X}}\right)$$

Where $\max(y, 0)$ ensures that we do not consider pre-birth mortalities for cohorts C_{-25} through C_{-1} or the mortality of years past for cohorts C_1 through C_{100}. After scaling up the interventions, the risk becomes

$$\mathrm{P_y(X|adjusted)} = 1 - \left(1 - M_{\max(y,0),y}\right) \times \cdots \times \left(1 - M_{\mathrm{X,y}}\right)$$

Now, lives saved below X is the sum

$$\text{Under-X lives saved} = \sum_{\mathrm{y}=-25}^{100} \left(\left(\mathrm{P_y(X|baseline)} - \mathrm{P_y(X|adjusted)}\right) \times \mathrm{N_y}\right)$$

Finally, for an individual in cohort y, we can calculate healthy life expectancy (HLE) based on the mortality rates and disability weights in the baseline matrices (i.e., $\mathrm{HLE_{baseline,y}}$) and in the adjusted matrices (i.e, $\mathrm{HLE_{adjusted,y}}$). The healthy life-years (HLYs) gained is now simply

$$\mathrm{HLYs\ gained_y} = \mathrm{HLE_{adjusted,y}} - \mathrm{HLE_{baseline,y}}$$

Total HLYs gained from scaling up one or more interventions then becomes the sum

$$\text{Total HLYs gained} = \sum_{\mathrm{y}=-25}^{100} \left(\mathrm{HLYs\ gained_y} \times \mathrm{N_y}\right)$$

where N_y is the number of individuals in cohort y.

Demographic projection model

The above approach describes how to compute changes in health outcomes in a static population, with one major output being changes in age-, sex-, and cause-specific mortality rates. To translate these into "real" projected populations, and to account for changing population size due to fertility, we employ a demographic model that uses the cohort component projection method (CCPM). The CCPM is based on the primary determinants of population dynamics: fertility, mortality, and migration. The initial population structure, segmented by sex and categorized by discrete age groups from 0 to 100 years, is based on the 2022 release of the World Population Prospects (WPP) by the United Nations Population Division.

We initiate our projections with a detailed population age structure, delineated by sex and organized into single-year age brackets, ranging from 0 to 100 years. For fertility, we utilize the age-specific fertility rates (ASFR) provided by the WPP. The number of births is calculated by multiplying the number of females in each reproductive age group (typically ages 15 to 49) by the corresponding ASFR, and integrating across all reproductive ages to include the entire fertility span:

$$B(t) = \int_{a=15}^{49} ASFR_f(a,t) \times P_f(a,t)da$$

However, due to the granularity of the data and the necessity for computational efficiency, we opt for a discrete approximation:

$$B(t) = \sum_{a=15}^{49} ASFR_f(a,t) \times P_f(a,t)$$

For mortality changes, we use the life tables that are based on the population size and structure and mortality patterns in the starting year of the analysis. The survivorship of individuals in the population is calculated using life table survivor rates, $S(a,t)$, which give the probability of surviving from age a to age $a+1$. This allows us to compute the population at each age and sex in the subsequent year:

$$P_s(a+1, t+1) = P_s(a,t) \times S_s(a,t)$$

Here, s denotes the sex subscript, distinguishing between male (m) and female (f) populations. Finally, the population projection is refined by incorporating net migration, $M_s(a,t)$, for each age and sex:

$$P_s^*(a+1, t+1) = P_s(a+1, t+1) + M_s(a, t+1)$$

The total adjusted population for each age and sex in the subsequent year is thus the sum of the survivors from the preceding year and the net migrants. These equations collectively form the foundation of our demographic projections, providing a comprehensive account of how a population would evolve differently in the baseline and adjusted scenarios, depending on the interventions and coverage targets chosen.

Cost model

Our cost model generally followed the approach outlined by Watkins and colleagues in DCP3.[11] In brief, we searched the literature for estimates of the annual unit cost (defined per population or per case treated, depending on the intervention) of each of the interventions described below. (Data sources for each intervention are also provided below.) To each intervention-specific unit cost $c_{i,lit}$presented in the literature, we added in health system strengthening costs to each unit cost estimate c and intervention i.

$$c_i = c_{i,lit} + \alpha \cdot\ c_{i,lit} + \beta \cdot (c_{i,lit} + \alpha \cdot\ c_{i,lit})$$

As in DCP3, α is a markup reflecting facility-level "indirect" costs (e.g., utilities, maintenance, administration, laboratory and pathology services, etc.), calculated based on Access, Bottlenecks, Costs, and Equity (ABCE) Project data from the Institute for Health Metrics and Evaluation. The α markup was calculated by intervention platform (7.4% for outpatient facilities and 27% for inpatient facilities) based on estimates of the proportion of total cost from infrastructure, administration, and nonmedical services in Kenya, Uganda, and Zambia.
The β is a markup reflecting "above-facility" health system costs including supply chain, financing, governance and administration, and health information systems, set at 17% as per DCP3. We included these costs in our model to reflect the importance of investing in health systems to support delivery of specific interventions. (These costs were only added on when they were not included in the original studies.)

Unit costs were taken from representative studies based in single countries. These costs were extrapolated to all other LICs and MICs under the assumption that traded goods would not vary across countries, on average, and non-traded goods and services would vary in proportion to national income. Hence the unit cost in the target country y with gross national income (GNI) per capita $S_y$is estimated as

$$c_{i,y} = (\delta \cdot c_{i,x} \cdot \frac{S_y}{S_x}) + (1 - \delta)\ \cdot c_{i,x}$$

for unit cost $c_i$in the originating country x with gross national income per capita S_x and a traded proportion of total unit cost equal to δ. On average, $\delta$was around 0.3, but we computed this proportion separately for each unit cost data point used. In a few instances, we used updated

drug prices from Management Sciences for Health (MSH) in lieu of drug costs cited in the study (see below), and so the study-specific δ was adjusted further as necessary.

All costs were converted and inflated to 2022 US dollars using procedures described by Watkins and colleagues.[11] Unit cost estimates were combined with estimates of populations in need and estimates of population coverage to estimate intervention costs at a population level, $C_{i,pop}$:

$$C_{i,pop} = \sum_{i=1}^{n} c_i \cdot w_i \cdot p_i$$

where $w_i$is the proportion of the target population covered by intervention i and $p_i$is the estimated number of persons treated by intervention i, also referred to as the "population in need." The population in need of each intervention is usually derived from disease-specific incidence or prevalence estimates, with some adjustments based on the properties of the intervention. For example, if 80% of persons with disease X are eligible for intervention i, we multiply the prevalence of disease X by 0.80 (we call this the "treated fraction").

We assumed that c_i remained constant (in 2022 US dollars) throughout the analytic horizon, but we used year-specific estimates of $p_i$from the demographic model and year-specific values of w_i specified in our projection model (see above). This approach allowed us to generate a stream of population-level costs for all interventions, summed together to calculate the overall "package" cost. The summation was done by year for the baseline scenario (i.e., no change in w_i) and various intervention scenarios where w_i was increased as a function of time. The difference between these two streams of costs, then, is the "incremental cost" of the intervention scenario, which corresponds to an improvement in health that results from an increase in intervention coverage over the same time.

The initial outputs of the FairChoices cost model were then compared to the findings from the DCP3 costing paper, specifically regarding the share of total health system costs due to different interventions. In some cases, an intervention's or module's cost deviated significantly from the previous study, so these costs were manually re-scaled to match the envelope of overall costs from the previous study while maintaining the distribution of costs in this analysis. In other words, the results below reflect a triangulation of the preliminary cost estimates from the beta version of the FairChoices model and the DCP3 cost analysis.

Preliminary cost estimates

Table 1 presents our estimates of the incremental cost of each of the interventions and of the 19 "modules" that include these interventions. The findings below are presented as the (population-weighted) average across 63 low- and lower-middle-income countries that account for >90% of the total population and disease burden in these two country income groups. Of course, the incremental cost of achieving full coverage of all interventions will vary by country.

Table 1. Costs of priority interventions and modules.

Community-based primary healthcare teams	
Infectious and maternal health conditions	
1- Routine childhood immunization	
BCG vaccine	0.0059
MMR vaccine	0.047
Pentavalent vaccine (DPT-HepB-Hib)	0.025
Pneumococcal vaccine	0.063
Polio vaccine (Oral) (IPV)	0.0075
Rotavirus vaccine	0.067
Module total	**0.22**
2- Treatment of acute childhood illness	
Intermittent malaria prevention during pregnancy	0.090
Intermittent malaria prevention in infancy	0.0072
P. Vivax treatment	0.0032
Prevention of relapse in vivaxovale malaria	0.00063
Treatment of acute diarrhea in children	0.041
Treatment of acute lower respiratory infections, children	1.0
Treatment of acute malnutrition	0.42
Treatment of measles	0.096
Treatment of severe acute malnutrition	0.23
Treatment of severe malaria 0-14yrs	0.030
Treatment of typhoid and paratyphoid in children	0.0036
Treatment of uncomplicated malaria	0.28
Module total	**2.2**
3- Pregnancy and childbirth services	
Antenatal care	1.8
Early care for newborn	0.092
Early detection and treatment of neonatal sepsis and pneumonia	0.14
Management of maternal sepsis	0.0016
Management of postpartum haemorrage	0.00064
Safe delivery	0.10
Treatment of ectopic pregnancy	0.0062
Module total	**2.2**
4- Tuberculosis	
Extensively drug-resistant TB	0.0011
Management of drug susceptible extrapulmonary TB	0.13
Management of drug susceptible pulmonary TB	0.20
Multidrug-resistant TB	0.52
TB preventive therapy (Isoniazide) for high risk people (e.g. PLHIV)	0.016

Module total	**0.87**
5- HIV/AIDS	
Management of HIV	3.2
PrEP for population at high risk of HIV (in high prevalence settings)	0.45
Treatment of chlamydia	0.036
Treatment of gonorrhea	0.14
Treatment of PID (Pelvic Inflammatory Disease)	0.11
Treatment of syphilis	0.070
Treatment of trichomoniasis	0.022
Voluntary medical male circumcision	0.0050
Module total	**4.0**
NCD and injury-related conditions	
6- Basic cardiovascular and respiratory care	
Longitudinal management of asthma	0.42
Longitudinal management of COPD	0.33
Longitudinal management of diabetes mellitus type 1	2.1
Longitudinal management of diabetes mellitus type 2	2.5
Primary prevention with absolute CVD risk	1.1
Secondary prevention of ischemic heart disease	0.51
Secondary prevention of stroke	0.17
Module total	**7.1**
7- Mental health care	
Management of anxiety disorders	0.26
Management of bipolar disorder	2.6
Management of depression	0.22
Management of psychotic disorders	0.068
Management of PTSD	0.34
Opioid Agonist Treatment (OAT) and psychosocial support	0.0079
Screening and brief intervention for AUD	0.17
Module total	**3.6**
Health system interventions	
8- Family planning	
Family planning	0.26
Module total	**0.26**
9- School-age child and adolescent development	
Human Papilloma virus (HPV) immunization	0.20
Vision prescreening by teachers	0.47
Module total	**0.67**
10- Custodial and palliative care	
Management of dementia	0.11
Palliative Care	1.4

Module total	**1.5**
11- Public health functions	
Public health functions	0.97
Module total	**0.97**
12- Primary care functions	
Primary care functions	1.7
Module total	**1.7**
Specialized first-level delivery platforms	
NCD and injury-related conditions	
13- Primary surgical care	
Management of appendicitis	0.027
Management of burns	0.00010
Management of gastrointestinal bleeding	0.0043
Management of ileus and intestinal obstruction	0.021
Management of lower extremity injuries	1.9
Management of pelvic injury (including urogenital)	0.18
Management of thoracoabdominal injury	0.13
Management of upper extremity fractures	1.3
Management of wounds (excluding burns)	0.12
Module total	**3.7**
14- Enhanced cardiovascular and respiratory care	
Longitudinal management of chronic heart failure	0.23
Management of acute heart failure	2.1
RHD secondary prevention	0.0039
Treatment of acute coronary syndromes	0.38
Treatment of acute exacerbation of asthma	0.25
Treatment of acute exacerbation of COPD	0.18
Module total	**3.2**
Health system interventions	
15- Rehabilitation	
Exercise based cardiac rehabilitation	0.13
Exercise-based pulmonary rehabilitation of COPD	0.20
Rehabilitation for extremity injury	0.47
Rehabilitation of stroke	0.15
Module total	**0.95**
16- Dental care	
Dental care	0.49
Module total	**0.49**
17- Emergency care functions	
Emergency care functions	2.2
Module total	**2.2**

Referral clinics and hospitals	
NCD and injury-related conditions	
18- Basic cancer care	
Screening and treatment of pre-invasive cervical cancer	0.49
Treatment of early-stage breast cancer	0.044
Treatment of cervical cancer	0.29
Treatment of early-stage colorectal cancer	0.35
Module total	**1.2**
19- Enhanced cancer care	
Organized screening for breast cancer	2.5
Treatment of breast cancer found through screening	0.40
Organized screening for colorectal cancer	5.6
Treatment of colorectal cancer found through screening	3.1
Treatment of acute lymphoblastic leukemia	0.0018
Treatment of Burkitt lymphoma	0.0012
Treatment of Hodgkin lymphoma	0.0028
Treatment of Wilms tumor	0.73
Module total	**12**

In total, scale-up of each of these interventions and modules to an additional 10% of the population would cost, on average, an additional 49 basis points (0.49%) of GDP in a typical low- or lower-middle-income country. The costliest modules—collectively accounting for two-thirds of the total incremental costs—would be enhanced cancer care (12), basic cardiovascular and respiratory care (7.1), HIV/AIDS (4.1), primary surgical care (3.7), and mental health care (3.6).

We also estimated the cost of scaling up all these interventions to 90% coverage by 2050, a level that probably would be required to achieve ambitious goals like the "50 by 50" goal proposed in GH2050 (Table 2). By 2050 these countries would need to be spending around 4% of GDP in total on priority interventions; along the way, they would need to be spending an *additional* 2% of GDP annually on these interventions to achieve that level of coverage.

Table 2. Costs of achieving full coverage of priority interventions and modules

Type of cost	**Low-income countries**	**Lower-middle-income countries**	**Both country income groups**
Annual incremental costs (USD, billions)	5.8	180	190
-As a share of current GDP:	1.1%	2.0%	2.0%
Total costs in 2050 (USD, billions)	13	370	380
-As a share of current GDP:	2.5%	4.1%	4.0%

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