Disease Control Priorities, 3rd Edition
Working Paper #24

Title: Costing universal health coverage: an update of the DCP3 costing model for the Lancet Commission on Investing in Health.

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Keywords: Cost, costing, universal health coverage, Commission on Investing in Health

1. Introduction

The final volume of Disease Control Priorities, Third Edition (DCP3), published in 2018, presented a concrete vision for universal health coverage (UHC) in a synthesizing chapter entitled, "Universal health coverage and essential packages of care."[1] In that chapter the authors drew on the contents of DCP3's 21 essential packages of health interventions to develop a model UHC benefits package called "essential UHC" (EUHC). A more focused sub-package, called the "highest priority package" (HPP) was also developed using criteria adapted from a 2014 WHO consultation on equity and UHC.[2] The chapter also presented estimates of the potential costs of EUHC and the HPP in low-income countries (LICs) and lower-middle-income countries (lower-MICs). The methods, data, and approach used in the costing exercise were detailed in DCP3's Working Paper #20.[3]

Prior to the publication of DCP3, the 2013 *Lancet* Commission on Investing in Health (CIH) laid out an investment framework for achieving a "grand convergence" in global health, particularly around rates of child and maternal mortality and around HIV/AIDS and tuberculosis death rates.[4] The CIH was informed by the early stages of DCP3 and was influential to DCP3's later thinking on priority health benefits packages and essential UHC. In January 2018, Richard Horton, editor-in-chief of the *Lancet*, invited the CIH to prepare a paper that reassessed the original claims and analyses of the CIH in 2013 five years on and in light of a changed global health landscape.[5] One major impetus for this invitation was the upcoming 40th anniversary of the Declaration of Alma-Ata; this declaration will be celebrated at a conference in Astana, Kazakhstan, where a new declaration will be penned to recommit countries to the goal of primary healthcare (PHC) and Health for All within the context of the modern UHC movement.

The CIH's report for the 40th Anniversary of Alma-Ata will be published on October 20, 2018 in a special issue of the *Lancet*.[6] In that report, the commissioners -- who overlap significantly with DCP3 authors, editors, and Advisory Committee members -- draw heavily on the notion of EUHC developed in DCP3 and present updated estimates of the cost of EUHC and the HPP to support the "grand convergence" agenda and the broader EUHC agenda (ie., including interventions for other infectious diseases, noncommunicable diseases, and injuries). The present working paper builds on DCP3's previous working paper on UHC costing by providing updates in a few important dimensions and providing additional details to support the figures presented in the new CIH paper.

2. Methods

For a detailed description of the DCP3 costing approach, methods, and data sources used, please see Working Paper #20.[3] In brief, the costing model used a "comparative statics" approach, looking at the likely change in the aggregate cost of a defined package of health interventions that would occur following an instantaneous increase in population coverage from current coverage to some target level (here, 80%). The model drew on published unit cost estimates for interventions (in most cases) and original bottom-up costing (in a few cases), except for essential surgery, which was costed using a top-down approach (see below). Estimates of the population in need of each intervention were taken from global demographic and epidemiological datasets. Estimates of current coverage of interventions were taken from the WHO Global Health Observatory, scientific literature, or expert opinion. Costs were presented for the aggregate populations in LICs (n = 34) and lower-MICs (n = 49) using country income

classifications from the 2014 World Development Indicators. As throughout DCP3, costs in that working paper were presented in 2012 US dollars.

2.1 Update to 2016 United States Dollars

We first updated all our unit cost estimates to 2016 US dollars. In most cases, original unit cost data were taken from a single study in a single country and year, so the costs were simply converted and inflated from their original values to 2016 US dollars. This was done by (i) converting published cost estimates to local currency units for the year in which study data were collected, (ii) inflating to 2016 costs in local currency units using consumer price index data, and then (iii) converting from local currency units to US dollars using mid-2016 exchange rates.[7]

In a number of cases, however, we used cost estimates that were calculated as average per-capita costs in LICs and in lower-MICs. In this situation (i.e., income-group averages) there is no consensus in the literature as to the best method for inflating currency values for groups of countries. Three general approaches have been proposed: using the inflation rate for the median country in the group, conducting a principal component analysis of country panel data on inflation, and using the average country inflation rate, weighted by GDP.[8] We chose the latter, since this approach would most easily replicable with updated GDP estimates in subsequent years, and it would be straightforward to implement. The final inflation factors (2012 – 2016) we used for LICs and lower-MICs were 1.25 and 1.32, respectively.

2.2 New Methods for Adjusting Unit Cost Data

Extrapolation of unit cost estimates from one country to other poses a few theoretical and methodological challenges, two of which are (i) differences in cost structures and (ii) differences in the cost of labor and non-traded goods. In the original DCP3 working paper we dealt with the

former issue by only using unit cost data that represented long-run average costs – i.e., where cost structures across countries could be assumed to be similar so long as the ingredients were the same. We dealt with the second problem by partitioning each unit cost estimate into a traded and a non-traded proportion. The non-traded proportion was assumed to be 70% in most cases unless evidence suggested otherwise. The absolute value of this portion of the cost was then adjusted up or down to LIC and lower-MIC average levels using ratios of healthcare worker salaries in specific countries (i.e., the primary cost studies) vs. average salaries in either income group. (Working Paper #20 provides more details.) For the present working paper, we moved from using ratios of healthcare worker salaries to using ratios of GNI per capita. The rationale for this choice was the simplicity and wide availability of GNI data, which are annually updated as compared to labor cost data, which were extracted from once-off analyses by the WHO-CHOICE project. Excluding a handful of very high-income countries that were outliers, the correlation between skilled healthcare worker salaries and GNI per capita across 158 countries with available data was 0.93, suggesting that the move to using GNI data would not substantially alter our original findings.

2.3 Revision of Essential Surgery Package Costs

In DCP3 Working Paper #20 we relied on cost data from Levin and colleagues (forthcoming) that drew heavily on empirical estimates of first-level hospital expenditures on surgical services. The Working Paper describes the approach in greater detail. Drawing on these estimates from Levin and colleagues, we estimated the total and incremental per capita costs of the surgery package to be US$ 2.9 and US$ 1.3 (respectively) in LICs and US$ 2.6 and US$ 0.97 (respectively) in lower-MICs, equating to about 2-4% of the total cost of the EUHC package. Expert review of these estimates and comparison with other literature suggested that they were

lower than expected. Further, the approach used to calculate the surgery package costs was not entirely consistent with the methods used for the rest of the EUHC interventions. As a result, we decided to re-cost the surgery package using the same methods as the rest of the package (i.e. drawing on unit cost data, estimates of population in need, and estimates of current coverage).

Our new source of unit cost data was a modeling study by Verguet and colleagues for the 2015 *Lancet* Commission on Global Surgery.[9] They estimated the unit cost of a representative surgical procedure (caesarean section) by synthesizing literature estimates of the cost of this procedure in a wide range of countries. The cost per operation was estimated at US$ 179 in LICs and US$ 219 in lower-MICs. We inflated these estimates to 2016 US dollars. Based on expert opinion, we then adjusted this representative cost up or down by factors of 5-10 according to the type of platform (i.e., simpler vs. more complex procedure than caesareans section in a first-level hospital operating theater). For example, reduction of non-displaced fractures could be accomplished by a general practitioner (not a surgeon) in an outpatient clinic using oral sedatives and analgesics rather than a full-fledged operating theater; the unit cost of caesarean section was multiplied by 0.1 to reflect these lower costs. As another example, repair of obstetric fistula can only be accomplished in a specialized center by a qualified surgical subspecialist, and the operating costs are higher than those of a caesarean section; the unit cost of caesarean section was multiplied by 5 to reflect these higher costs.

Next, we estimated the population in need of each procedure using incidence and prevalence data for the most common diseases or injuries for which each procedure was indicated. We drew on Global Burden of Disease 2016 study estimates of incidence and prevalence by country and aggregated these estimates into our two income groups.[10] In a few cases, e.g., fractures and osteomyelitis, there were no corresponding GBD cause categories, so

we had to rely on the published literature from the most representative country settings. We then adjusted the crude estimate of the population in need of each procedure on the basis of other literature and/or expert opinion. For example, we assumed that 80% of "appendicitis" (per GBD) would be managed surgically (C. Mock – personal communication). As another example, we used Guttmacher Institute data on the distribution of the use of different family planning measures by country income group to adjust our estimates of population in need of each type of (surgical) family planning measure in the package.[11] Of note, some surgical procedures, e.g. assisted vaginal delivery, had already been costed in other DCP3 volumes, so we simply incorporated those cost estimates into the surgery package costs.

Finally, we made a major revision to our estimates of the current coverage of essential surgical services. As part of the *Lancet* surgery commission, Alkire and colleagues conducted an analysis and modeling study of DHS data to determine the proportion of the population with access to surgical care by country income group. They found that 0.72% of the population in LICs and 3.4% of the population in lower-MICs currently have access to surgical care, a major difference from the "implied" coverage numbers (56% and 61%, respectively) we used in Working Paper #20 by back-calculating coverage data from Levin and colleagues' estimates of current expenditure. These new baseline coverage estimates imply that to a first approximation the total and incremental costs of the surgery package would be the same.

2.4 Projections of Domestic Resources for Health

The 2013 CIH report included projections of GDP growth in its analysis of the cost of the package of interventions directed at achieving grand convergence. The main finding of that analysis was that, given the likely economic growth in LICs and MICs between 2011 and 2035, most of the cost of the package could be financed through increased revenues resulting from

increased national income (about 1-3% of additional resources freed up through GDP growth). A 2017 paper by Stenberg and colleagues at WHO also including estimates of "fiscal space" for financing their list of interventions (and health system investments) to meet the SDG3 targets.[12] They found that many MICs (including all upper-MICs) would be able to afford these reforms but that many LICs would face a financing gap, even under a more modest investment scenario.

In the present working paper, we produce estimates of domestic resources for health for the new CIH report that also provide additional context for our EUHC cost estimates. Barroy and colleagues recently reviewed the literature on the magnitude of effects that different financing measures might have on the amount of domestic resources for health.[13] They conclude that two of the most significant (and evidence-supported) sources are macroeconomic growth (i.e., increases in revenues resulting from increased country GDP) and increased prioritization of health (i.e., increase in the share of GDP that is devoted to health).

We devised two scenarios for looking at expanding domestic resources for health. In the first scenario, we looked only at the growth in GDP between 2015 and 2030. Assuming the share of GDP devoted to health (from domestic sources) remained fixed over time, we calculated the total available resources for health in 2030 in the two country income groups. In the second scenario, we drew on the same estimates of GDP growth and allocation to health as in the first scenario but also included a growth rate of 1% per year in the share of GDP devoted to health. In simpler terms, scenario 1 only looks at macroeconomic growth, whereas scenario 2 looks at macroeconomic growth and increased prioritization of health between now and 2030. (A 1% annual increase in health prioritization is admittedly a conservative figure compared to what could be possible in many countries.)

To generate our projections of resources for health over the coming years, we used data from the IMF World Economic Outlook by country.[14] The following countries did not have data from the IMF so were excluded from the analysis: among LICs, the Democratic People's Republic of Korea and Somalia (4.4% of the population of LICs in 2015), and among lower-MICs, Kiribati, Federated States of Micronesia, Samoa, Sao Tome and Principe, Solomon Islands, the Syrian Arab Republic, Vanuatu, and the West Bank and Gaza Strip (0.90% of the population of lower-MICs in 2015).

The IMF projections only extend to 2023, so for 2024-2026, we used the average growth rate over 2021-2023 capped at 6% annually (i.e., if the annual rate over 2021-2023 was greater than 6%, we used 6% as the annual growth rate for 2024-2026). For 2027-2029, we used the average growth rate over 2021-2023 capped at 5% annually, and for 2030-2035, we used the average growth rate over 2021-2023 capped at 4% annually. This method of course assumes that long-run growth rates will be smaller than have been observed in recent years or are projected for the next few years for countries with exceptionally strong growth.

In addition, we used data on current health expenditure by financing source from the WHO's Global Health Expenditure Database, last updated in 2017 for the years 2000-2015.[15] For scenario 1, we took 2015 levels of general government expenditure on health (from domestic sources) as a share of GDP for each country and multiplied these by the GDP projections described above to get future levels of public spending on health. For scenario 2, we increased the share of general government expenditure on health vs. GDP by 1% annually over each year from 2015-2035, then multiplied by the GDP projections to get the alternative levels of future public spending on health. Of note, for the CIH report we took projections for the year 2035; for this paper we report our projections for the year 2030, since this is aligned with DCP3's

estimates of mortality reduction in the year 2030 and DCP3's emphasis on priorities during the SDG3 period (2015-2030).[16]

3. Results

Table 1 presents the overall estimates of updated costs of EUHC and the HPP. The cost figures are higher than those in Working Paper #20 due to (a) the use of 2016 rather than 2012 US dollars (which has more of an impact in lower-MICs due to their higher inflation rate and higher absolute levels of costs) and (b) revision of the essential surgery package costs. In the latter case, the updated surgery costs were as follows: total and incremental annual costs per capita of US$ 8.7 and US$ 8.3 (respectively) in LICs and US$ 13 and US$ 11 (respectively) in lower-MICs, equating to about 11-12% of the total cost of the EUHC package (as compared to 2-4% of the total cost in the previous costing paper). As a share of per-person income in 2015, the total costs in LICs and lower-MICs would be 12% and 6% (respectively) and the incremental costs 9.4% and 3.7% respectively. The HPP cost estimates would be roughly half the EUHC cost estimates.

We break down the HPP and EUHC annual incremental costs by health system delivery platform and by health issue in Table 2. On average across country income group and UHC package (i.e., EUHC vs. HPP), the proportion of incremental costs spent on each of the platforms was about 1% for population-based health interventions, 7% for referral and specialized hospitals, 14% for community, 28% for first-level hospitals, and 49% for health centers. Grand convergence interventions comprised 27% of incremental annual costs, and interventions for other health issues comprised the remainder of costs (73%).

In Table 3, we present our projections of domestic resources for health in 2030 based on GDP growth only (scenario 1) and GDP growth plus reprioritization of health (scenario 2). In both LICs and lower-MICs, GDP growth over the next 15 years is estimated at around 4% annually, but the population growth rate in lower-MICs is projected to be half the rate in LICs (1% vs. 2%, respectively). As a result, we estimated that general government expenditure on health (from domestic sources) in LICs would grow from US$ 8.8 per capita in 2015 to US$ 14 per capita (scenario 1) or US$ 18 per capita (scenario 2) in 2030. In lower-MICs, however, this quantity is estimated to grow from US$25 per capita in 2015 to US$ 47 per capita (scenario 1) or US$ 58 per capita (scenario 2) in 2030.

These figures imply substantial financing gaps for DCP3's packages. In LICs, the financing gap for the HPP would be US$ 26 per capita (scenario 1) or US$ 22 per capita (scenario 2), and the financing gap for EUHC would be US$ 62 per capita (scenario 1) or US$ 58 per capita (scenario 2). In lower-MICs, the financing gap for the HPP would be US$ 14 per capita (scenario 1) or US$ 3 per capita (scenario 2), and the financing gap for EUHC would be US$ 73 per capita (scenario 1) or US$ 62 per capita (scenario 2).

4. Discussion

In this working paper, we update DCP3's estimates of the cost of EUHC and the HPP to 2016 US dollars and make a few methodological improvements to the unit cost data that underlie our models. Our conclusions are broadly similar to the conclusions of Working Paper #20: both EUHC and the HPP require substantial investments beyond what LIC and lower-MIC health systems are currently spending on these interventions, and across LICs and lower-MICs the

magnitude of those additional costs is on the order of US$ 30-40 per person in the case of the HPP and US$ 60-70 in the case of EUHC.

This paper also illustrates the large challenges that LICs and lower-MICs face in financing a prioritized package of interventions for UHC. This is a significantly more pessimistic conclusion than the 2013 CIH report, which relied on GDP projections that were much more positive on the prospects for LICs. For example, in April 2013 the IMF projected that real GDP growth in sub-Saharan Africa would be 5.7% on average over 2013-2017. In reality, growth in sub-Saharan Africa over this period was only 3.6%.

As a result, we find that lower-MICs *might* be able to afford the HPP by 2030 as long as their macroeconomic growth trajectories continue along the lines of recent history and they commit to reprioritizing health (with a target of *at least* 1.5% of GDP devoted to the UHC benefits package by the year 2030). It should be noted that our projections for lower-MICs are heavily influenced by trends in India, which is projected to have particularly strong growth between 2018 and 2023 (7-8% per year) but has a very low share of GDP devoted to health (about 1% in 2015) relative to other LICs and MICs.

The fiscal situation in LICs is much more challenging. Financing even the HPP would require US$ 22-26 more than is currently projected to be available in these countries by 2030. The incremental per capita cost of the grand convergence-related subset of HPP interventions would be US$ 9.9, which would make these interventions affordable in our scenario 2 but not scenario 1 (which project an additional US$ 9 and US$ 5, respectively). However, it should be noted that the incremental cost estimates assume a target coverage of 80%. Merely reaching 80% coverage of the grand convergence-related HPP interventions would not permit LICs to achieve grand convergence and the SDG3 health targets for child, maternal, and infectious disease

mortality; DCP3 Working Paper #21 found that a coverage level of about 95% would be required, implying an annual incremental cost of US$ 12 per capita and a financing gap of US$ 3-7 per capita (or US$ 2.3-5.9 billion). The latter figures provide a first approximation of the minimum amount of direct country support (from official development assistance for health) that would be required to finance the grand convergence and SDG3 agendas in LICs.

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6. Tables and Figures

Table 1. Topline estimates of the cost of EUHC and the HPP by country income group.

	Low-income countries		Lower-middle-income countries	
	HPP	**EUHC**	**HPP**	**EUHC**
Incremental annual cost (in billions of 2016 US dollars)	US$ 24	US$ 51	US$ 93	US$ 200
Incremental annual cost per person	US$ 27	US$ 57	US$ 35	US$ 73
Total annual cost (in billions of 2016 US dollars)	US$ 36	US$ 68	US$ 160	US$ 320
Total annual cost per person	US$ 40	US$ 76	US$ 61	US$ 120
Incremental annual cost as a share of current GNI per person	4.4%	9.4%	1.8%	3.7%
Total annual cost as a share of current GNI per person	6.5%	12%	3.1%	6.0%

Notes: in 2015, the population of low-income countries was 0.90 billion and aggregate GNI was US$ 0.55 trillion (in 2016 US dollars). The population of lower-middle-income countries was 2.7 billion and aggregate GNI was US$ 5.3 trillion.

Table 2. Distribution of EUHC and HPP annual incremental costs by platform and type of health issue

		Low-income countries		Lower-middle-income countries	
		HPP	**EUHC**	**HPP**	**EUHC**
Population-based health interventions	Grand convergence	0.30%	0.76%	0.39%	0.65%
	Other health issues	0.048%	1.4%	0.057%	1.1%
Community	Grand convergence	8.4%	7.5%	10%	6.2%
	Other health issues	2.3%	7.0%	1.4%	7.9%
First-level hospitals	Grand convergence	6.9%	5.2%	8.2%	4.2%
	Other health issues	14%	22%	19%	24%
Health centers	Grand convergence	9.4%	8.5%	12%	7.6%
	Other health issues	22%	43%	38%	42%
Referral and specialized hospitals	Grand convergence	0.0%	0.00059%	0.0%	0.11%
	Other health issues	5.0%	5.105%	10%	6.2%

Notes: percentages in each column sum to 100%; each percentage represents that share of overall incremental costs by package (HPP and EUHC) and country income group (low- and lower-middle-income) that is delivered on various health sector platforms and towards different health issues. Each of the five delivery platforms (far left column) delivers two different types of interventions: (a) interventions directed towards one of the “grand convergence” conditions contained in the 2013 CIH report (under-5 mortality, maternal mortality, adult HIV/AIDS, adult tuberculosis, and neglected tropical diseases), and (b) interventions directed towards other health issues, such as other adult infections, noncommunicable diseases (including mental health disorders), and injuries.

Table 3. Potential domestic resources for health, 2015-2030, by country income group

			Low-income countries	Lower-middle-income countries
	Aggregate GDP (US$, trillions)	2015	US$ 0.72	US$ 5.4
		2030	US$ 1.7	US$ 12
	Annual GDP growth, 2015-2035		4.3%	4.0%
	Population (billions)	2015	0.86	2.7
		2030	1.3	3.4
	Annual population growth, 2015-2035		2.1%	1.0%
Scenario 1: GGHE-D as share of GDP stays constant for individual countries over 2015-2035	GGHE-D (US$, billions)	2015	US$ 7.6	US$ 69
		2030	US$ 17	US$ 150
	GGHE-D as share of GDP	2015	1.0%	1.3%
		2030	1.0%	1.3%
	GGHE-D per capita (US$)	2015	US$ 8.8	US$ 25
		2030	US$ 14	US$ 47
Scenario 2: GGHE-D as a share of GDP grows by 1% annually over 2015-2035	GGHE-D (US$, billions)	2030	US$ 21	US$ 180
	GGHE-D as share of GDP	2030	1.3%	1.5%
	GGHE-D per capita (US$)	2030	US$ 18	US$ 58

Notes: geometric growth rates are used for economic indicators; growth refers to growth in real rather than nominal terms. Exponential growth rates are used for demographic indicators. GGHE-D refers to general government expenditure on health from domestic sources. All economic data are in 2016 US dollars. Population data differ slightly between Table 3 and Table 2 because some countries were excluded from the calculations in Table 3 (see text for details).