

Universal health coverage and intersectoral action for health: key messages from *Disease Control Priorities*, 3rd edition



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The World Bank is publishing nine volumes of *Disease Control Priorities*, 3rd edition (DCP3) between 2015 and 2018. Volume 9, *Improving Health and Reducing Poverty*, summarises the main messages from all the volumes and contains cross-cutting analyses. This Review draws on all nine volumes to convey conclusions. The analysis in DCP3 is built around 21 essential packages that were developed in the nine volumes. Each essential package addresses the concerns of a major professional community (eg, child health or surgery) and contains a mix of intersectoral policies and health-sector interventions. 71 intersectoral prevention policies were identified in total, 29 of which are priorities for early introduction. Interventions within the health sector were grouped onto five platforms (population based, community level, health centre, first-level hospital, and referral hospital). DCP3 defines a model concept of essential universal health coverage (EUHC) with 218 interventions that provides a starting point for country-specific analysis of priorities. Assuming steady-state implementation by 2030, EUHC in lower-middle-income countries would reduce premature deaths by an estimated 4.2 million per year. Estimated total costs prove substantial: about 9.1% of (current) gross national income (GNI) in low-income countries and 5.2% of GNI in lower-middle-income countries. Financing provision of continuing intervention against chronic conditions accounts for about half of estimated incremental costs. For lower-middle-income countries, the mortality reduction from implementing the EUHC can only reach about half the mortality reduction in non-communicable diseases called for by the Sustainable Development Goals. Full achievement will require increased investment or sustained intersectoral action, and actions by finance ministries to tax smoking and polluting emissions and to reduce or eliminate (often large) subsidies on fossil fuels appear of central importance. DCP3 is intended to be a model starting point for analyses at the country level, but country-specific cost structures, epidemiological needs, and national priorities will generally lead to definitions of EUHC that differ from country to country and from the model in this Review. DCP3 is particularly relevant as achievement of EUHC relies increasingly on greater domestic finance, with global developmental assistance in health focusing more on global public goods. In addition to assessing effects on mortality, DCP3 looked at outcomes of EUHC not encompassed by the disability-adjusted life-year metric and related cost-effectiveness analyses. The other objectives included financial protection (potentially better provided upstream by keeping people out of the hospital rather than downstream by paying their hospital bills for them), stillbirths averted, palliative care, contraception, and child physical and intellectual growth. The first 1000 days after conception are highly important for child development, but the next 7000 days are likewise important and often neglected.

Introduction

In 1993, the World Bank published *Disease Control Priorities in Developing Countries* (DCP1), an attempt to systematically assess value for money (cost-effectiveness) of interventions that would address the major sources of disease burden in low-income and middle-income countries (LMICs).¹ One motivation for DCP1 was to identify reasonable responses in highly resource-constrained environments to the growing burden of non-communicable disease and of HIV/AIDS in LMICs. The World Bank had highlighted the already substantial problem of non-communicable diseases in country studies for Malaysia² and China³ and in a Shattuck Lecture.⁴ Mexican scholars pointed to the rapid growth of

non-communicable diseases in Mexico and introduced the concept of a protracted epidemiological transition involving a dual burden of non-communicable diseases combined with significant lingering problems of infectious disease.^{5,6} The dual burden paradigm remains valid to this day. The World Bank's first (and only) World Development Report about health provided the first assessment of the global burden of disease, an assessment that underlined the importance of non-communicable diseases, which was consistent with subsequent assessments of global disease burden. It then drew heavily on findings from DCP1 to conclude that a number of specific interventions against non-communicable diseases (including tobacco control and multidrug

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secondary prevention of vascular disease) were attractive even in environments where substantial burdens of infection and insufficient dietary intake remained.^{7,8} The World Development Report also pointed to DCP1's finding that opportunities remained to reduce enormously the burden of child mortality and other mortality from these infections.⁹

The second edition of *Disease Control Priorities* (DCP2), published in 2006, updated and extended DCP1 most notably by explicit consideration of the implications for health systems of expanded coverage of high-priority interventions.¹⁰ One important linkage to health systems was through examination of selected platforms for delivering logistically related interventions that might be addressing quite heterogeneous sets of problems. Platforms often provide a more natural unit for investment (and for estimating costs) than do individual interventions. Analysis of the costs of providing platforms (and of health improvements they can generate in a given epidemiological environment) can thus help guide health-system investments and development. One example of a platform (within the larger platform of

first-level hospital) is the surgery service. A heterogeneous set of conditions is addressed by surgical equipment and surgically trained staff. Both *Disease Control Priorities*, 3rd edition (DCP3), and WHO's major investment case for health continue to use platforms and their associated costs as important organising concepts.¹¹ The DCP3 remit did not include assessment of the impact of DCP1 and DCP2 (although the Bill & Melinda Gates Foundation has commissioned such a review, emphasising DCP2 and early output from DCP3).

The focus of DCP3 has been on the content of a benefits package. DCP3 does not address two important dimensions of finance—the role of private finance and whether public finance should focus on the poor or be universal. That said, our modelling of the costs and consequences of benefits packages assume universal coverage and low or zero payment at point of service. Our costing estimates include, implicitly, the costs of personnel training and system strengthening, but addressing how to develop personnel and system was beyond the remit of the DCP3.

In this Review, we convey the main findings of DCP3 and, in particular, the conclusions concerning

Panel 1: Key messages from *Disease Control Priorities*, 3rd edition (DCP3)

- DCP3 has found it useful to organise interventions into 21 essential packages that group the interventions relevant to particular professional communities. Each package can contain both intersectoral interventions and health-system interventions. Specific findings from packages point to the attractiveness of widely available surgical capacity, the value of meeting unmet demand for contraception, the potential of a multipronged approach to air pollution, and the importance of maintaining investment in child health and development far beyond the first 1000 days of a child's life.
- Interventions were selected for packages by a systematic process using criteria of value for money, burden addressed, and implementation feasibility. Collectively, the 218 selected health-system interventions are defined to constitute essential universal health coverage (EUHC). A subset of 108 of these interventions, selected using more stringent criteria, are suggested as a highest priority package (HPP), constituting an important first step on the path to EUHC. Five platforms (population based, community level, health centre, first-level hospital, and referral hospital) provide the delivery base for EUHC. The specific interventions selected for the HPP and for EUHC, and the definitions of platforms and packages, are necessarily quite generic. Every country's definitions and selections will differ from these and from each other's. Nonetheless, we view DCP3's selections to be a potentially useful model list and a starting point for what are appropriately country-specific assessments. The package and EUHC concepts are new in DCP3 and are set up to be easily adapted to country-specific analyses.
- The costs estimated for the HPP and EUHC are substantial. The HPP is, however, affordable by low-income countries prepared to commit to rapid improvement in population health, and the EUHC is affordable by lower-middle-income countries. Many upper-middle-income countries have yet to achieve EUHC, and they might also find that the EUHC interventions are a useful starting point for discussion.
- To reduce premature deaths by 40% by 2030 (known as 40×30) is a goal for mortality reduction closely mirroring the quantitative content of the Sustainable Development Goal 3. Our calculations suggest that low-income countries implementing HPP and lower-middle-income countries implementing EUHC by 2030 will make substantial progress toward this 40×30 target but are likely to fall short (unless there is an unexpectedly substantial intersectoral action to raise excise taxes on tobacco and adopt other fiscal interventions to reduce behavioural and environmental risk factors for non-communicable diseases).
- DCP3 has shown that it is possible to identify the main sources of health-related financial risk and impoverishment, to estimate the value of risk reduction, and to use a new method developed for DCP3, the extended cost-effectiveness analysis, to help achieve efficiency in purchase of financial risk reduction. This concern for efficiency in (government) purchase of financial protection is new in DCP3, but DCP3 has made only a beginning in applying these methods. Much remains to be done.
- In addition to the aggregate conclusions of DCP3, each volume provides rich detail on policy options and priorities. This granularity in the volumes makes them of use to the implementation level of ministries as well as the policy level.

intersectoral policy priorities and essential universal health coverage. Beyond informing policy discourse, the granularity of analysis reported in DCP3's nine volumes is intended to serve officials within ministries at the implementation level. Beginning with DCP3 volume 1, on essential surgery, the first eight volumes of DCP3 (and related overviews of six of them in *The Lancet*) were published between 2015 and 2017. The final volume, with cross-cutting and synthesising chapters, will be published in early 2018. DCP3's key messages are summarised in panel 1, and the DCP3's nine volumes and their editors are listed in panel 2.

The division between intersectoral policies and health sector policies in DCP3's analyses and examples of the risk factors and conditions that the policies address are shown in figure 1. Importantly the DCP3 structure views the role of intersectoral action to be reduction of behavioural and environmental risks, which themselves affect the level of physiological risks and health outcomes directly. The health sector's role in reducing behavioural and environmental risk is viewed as modest—rather, the health sector's main role is in reducing (some of) the physiological risk factors and reducing the duration and severity of health conditions and their sequelae. Appropriate health sector policies also offer the potential for reducing health-related financial risks in a population.

DCP3 has four major objectives that go beyond previous editions. First, DCP3 addresses explicitly the financial risk protection and poverty reduction objective of health systems as well as provision of contraception, reduction in stillbirths, palliative care, and enhancement of the physical and cognitive development of children. Standard health metrics such as quality-adjusted life-years and disability-adjusted life-years usually do not address these other objectives of health systems, and DCP3 has endeavoured to be explicit about them and their importance. Second, DCP3 devotes systematic attention to disease prevention and the intersectoral determinants of health. Third, DCP3 organises interventions into 21 essential packages that reflect professional communities (panel 3). DCP3 defines a concept of essential universal health coverage (EUHC) in terms of the health-systems components of the 21 essential packages and further identifies a subset of EUHC termed the highest priority package (HPP) that can potentially be afforded by low-income countries and offers the most potential achievement (given limited resources) of health, financial protection, and other objectives. Finally, for both EUHC and HPP, DCP3 provides estimates (for low-income and for lower-middle-income countries) of the magnitude of their effect on mortality and of their incremental (ie, required expenditure above current levels) and total costs in 2030. In addition to these new elements, DCP3 updates the efforts of DCP1 and DCP2 to assemble and interpret the scientific literature on economic evaluation of health interventions.

Here we introduce the substantive topics addressed by DCP3 and relay our main conclusions. First, we briefly

Panel 2: Nine volumes of *Disease Control Priorities*, 3rd edition (DCP3)

The World Bank is publishing DCP3 between 2015 and 2018. By contrast with the single (very large) volume formats of DCP1 and DCP2, DCP3 appears in nine small and topical volumes, each with its own editors. Coordination between volumes has been provided by seven series editors, Dean T Jamison, Rachel Nugent, Hellen Gelband, Susan Horton, Prabhat Jha, Ramanan Laxminarayan, and Charles N Mock. The topics and editors of the individual volumes are listed below:

2015

Volume 1: Essential surgery

(edited by Haile T Debas, Peter Donkor, Atul Gawande, Dean T Jamison, Margaret E Kruk, and Charles N Mock, with a foreword by Paul Farmer)

Volume 3: Cancer

(edited by Hellen Gelband, Prabhat Jha, Rengaswamy Sankaranarayanan, and Susan Horton, with a foreword by Amartya Sen)

Volume 4: Mental, neurological, and substance use disorders

(edited by Vikram Patel, Dan Chisholm, Tarun Dua, Ramanan Laxminarayan, and María Elena Medina-Mora, with a foreword by Agnes Binagwaho)

2016

Volume 2: Reproductive, maternal, newborn, and child health

(edited by Robert E Black, Ramanan Laxminarayan, Marleen Temmerman, and Neff Walker, with a foreword by Flavia Bustreo)

2017

Volume 5: Cardiovascular, respiratory, and related disorders

(edited by Dorairaj Prabhakaran, Shuchi Anand, Thomas Gaziano, Jean Claude Mbanya, Yangfeng Wu, and Rachel Nugent, with a foreword by K Srinath Reddy)

Volume 6: Major infectious diseases

(edited by King K Holmes, Stefano Bertozzi, Barry R Bloom, and Prabhat Jha, with a foreword by Peter Piot)

Volume 7: Injury prevention and environmental health

(edited by Charles N Mock, Rachel Nugent, Olive Kobusingye, and Kirk R Smith, with a foreword by Ala Alwan)

Volume 8: Child and adolescent health and development

(edited by Donald A P Bundy, Nilanthi de Silva, Susan Horton, Dean T Jamison, and George C Patton, with a foreword by Gordon Brown)

2018

Volume 9: Disease control priorities: improving health and reducing poverty

(edited by Dean T Jamison, Hellen Gelband, Susan Horton, Prabhat Jha, Ramanan Laxminarayan, Charles N Mock, and Rachel Nugent, with a foreword by Bill and Melinda Gates and an introduction by Lawrence H Summers)

describe the context in which DCP3's analyses have been undertaken.

Context

Five considerations set the context for DCP3. The first four were the 20th century revolution in human health, the scientific underpinnings of that revolution, the high estimated returns to (carefully chosen) health investments, and the increasing implementation of universal health coverage (UHC) as a practical goal for domestic finance of health systems. Skolnik¹² provides further discussion of

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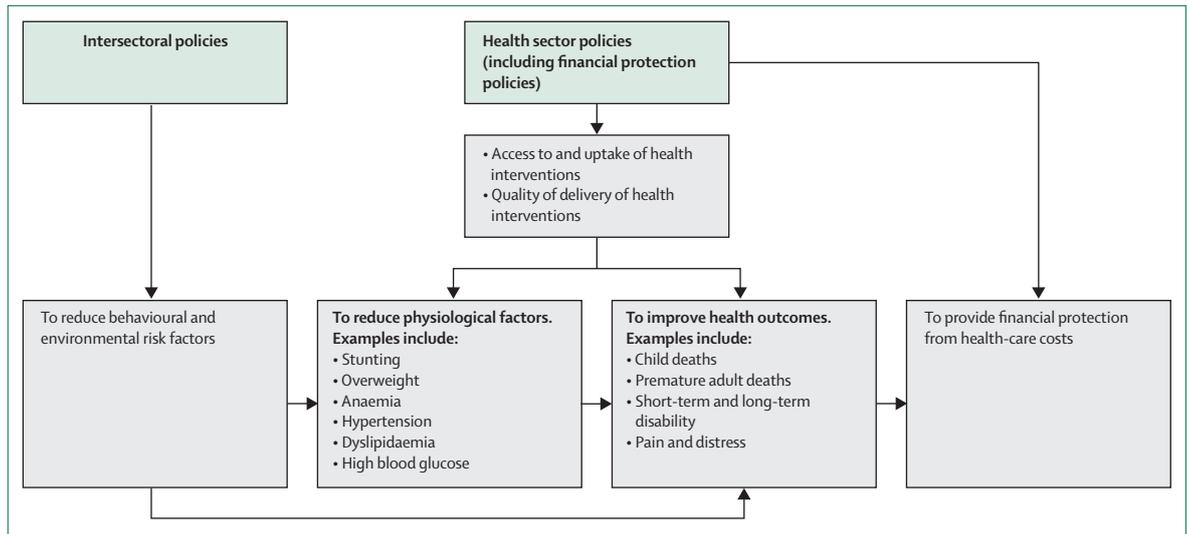


Figure 1: Policies for health

It is important to recognise that policies affecting health-sector finance, and hence the functioning and success of the health sector, often originate outside the health sector (eg, in social security agencies).

Panel 3: Clusters of essential packages*

Age-related cluster (packages 1–5)

- 1 Maternal and newborn health
- 2 Child health
- 3 School-age health and development
- 4 Adolescent health and development
- 5 Reproductive health and contraception

Infectious diseases cluster (packages 6–10)

- 6 HIV and sexually transmitted infections
- 7 Tuberculosis
- 8 Malaria and adult febrile illness
- 9 Neglected tropical diseases
- 10 Pandemic and emergency preparedness

Non-communicable disease and injury cluster (packages 11–17)

- 11 Cardiovascular, respiratory, and related disorders
- 12 Cancer
- 13 Mental, neurological, and substance use disorders
- 14 Musculoskeletal disorders
- 15 Congenital and genetic disorders
- 16 Injury prevention
- 17 Environmental improvements

Health services cluster (packages 18–21)

- 18 Surgery
- 19 Rehabilitation
- 20 Palliative care and pain control
- 21 Pathology

*Country applications will define packages in a way relevant to local policy. For example, the structure here distributes urgent interventions across packages, but in many contexts defining an emergency care package might prove more relevant.

these four issues. A fifth consideration concerns evolution in thinking about the international dimension of health finance—development assistance for health broadly defined. This context points to the importance of funding health systems adequately (a record of remarkable success and high economic returns) and of getting high value for money from the resources spent.

Chile exemplifies the two key elements of the 20th century revolution in human health. One is the sheer magnitude of improvement. As recently as in 1910, life expectancy was less than 32 years. By 2010, life expectancy exceeded 78 years. Second, time has narrowed cross-country differences. In 1910, world leaders (eg, Australia and New Zealand) had life expectancies almost 30 years higher than in Chile, but that gap had narrowed by 2010 to about 4 years. The magnitude of Chile’s success has been unusual, but the broad story it conveys is not. That said, very substantial gaps remain in health between countries, and a major purpose of DCP3 is to point very specifically to approaches to closing these gaps.

Nurturing continuation of scientific investment remains a policy priority, as was extensively discussed in DCP2. DCP3 has devoted less attention to research and development than did DCP2, in part because of the coverage there.^{13–17} Although research and development are discussed in several places,^{18,19} a careful mining of DCP3 for its implications for basic research and for new product development remains to be done. Income growth in the past century and past decades has contributed to increased life expectancy as have, to a greater extent, improvements in education levels and improved tools. But the availability of new tools and their rate of uptake appear to be the dominant sources of mortality decline.²⁰

Valuation of mortality decline (or health change more generally) is excluded from the global system of national income and product accounts. Economists have nonetheless expended substantial effort on tracing the effect of health improvements on household and national income and on assessing the economic value of the small reductions in mortality risk that have occurred year by year. The *Lancet* Commission on Investing in Health²¹ and the Copenhagen Consensus²² reviewed and extended the literature on the value of health improvements, pointing to high returns indeed.

As national incomes increase, countries typically increase the percentage of national income devoted to health. Equally significantly, they increase the proportion of health expenditures that are prepaid, usually through public or publicly mandated finance. Tedros Ghebreyesus, WHO's new Director-General, has reaffirmed WHO's commitment to UHC and to the use of evidence and data in support of achieving that goal.²³ The *Lancet* Commission on Investing in Health²¹ advocated variants on a pathway toward UHC (progressive universalism) that emphasised two initial priorities for action: universal coverage of publicly financed interventions and reductions of user payments at the point of service (for those interventions) to very low levels. An increased emphasis on domestic financing for UHC has led to the need for greater initial selectivity in the range of interventions to be financed in UHC packages. It should be noted that in many countries public finance has been successfully combined with private sector provision. Many considerations will influence national choices of how benefits packages will evolve over time. DCP3 is intended to contribute to the deliberation of these choices. A recent report from the Center for Global Development²⁴ provides valuable discussion of the considerations that might reasonably go into development of a benefits package.

With substantial income growth in (most) LMICs and an increasing number of countries committed to public finance of UHC, the role of development assistance is being reexamined.^{21,25} As the World Bank and others have long argued, finance ministers will often reduce domestic allocations to sectors receiving substantial foreign aid. The challenge to those concerned with aid effectiveness thus becomes one of identifying and supporting important activities that national finance ministries will plausibly under-finance (such as research and development, pandemic preparedness, and control of antimicrobial resistance). In a recent assessment, support for these global public goods was found to constitute more than 20% of development assistance for health broadly defined; the authors make the case that percentage should steadily increase over time.²⁶ This view of development assistance has clear implications for construction of model benefits packages for domestic finance: other things equal, domestic finance should emphasise services

having national importance and leave the finance of global (or regional) public goods to international finance. The DCP3 HPP does not include finance of pandemic preparedness for just this reason.

Packages, platforms, and policies

DCP3 defines packages of interventions as conceptually related interventions (eg, those dealing with cardiovascular disease or reproductive health or surgery). An objective of each DCP3 volume was to define one or more essential packages and the interventions in that package that might be acquired at an early stage on the pathway to UHC. The essential packages comprise interventions that provide value for money, are implementable, and address substantial needs. This matrix structure (with packages as the rows, intersectoral policies and health-systems platforms as the columns, and interventions as the entries) is novel to DCP3. It remains to be seen whether this structure is helpful, but the DCP3 authors, at least, have found it so.

Platforms are defined as logistically related delivery channels. Panel 3 shows how DCP3 groups EUHC interventions within packages that can be carried on different types of platforms.

The temporal character of interventions is very important for health-system development. Patients requiring non-urgent but substantial intervention (eg, repair of cleft lips and palates) can be accumulated over space and time enabling the efficiencies of high volume in service delivery. In DCP3, urgent interventions are dispersed across packages. They could, as plausibly, be grouped into a package of emergency care. Urgent interventions, which include a large fraction of essential surgical interventions, are ideally available at all times and close to where patients live, with important implications for dispersal of relevant platforms and integration of different services.²⁷ Non-urgent but continuing interventions to address chronic conditions (eg, secondary prevention of vascular disease or antiretroviral therapy for HIV-positive individuals) is a big and quite distinct challenge. One new product of DCP3 has been to explicitly categorise all essential interventions into one of these three temporal categories and to draw relevant lessons, including concerning cost, for health systems.

In total, 71 distinct intersectoral policies (fiscal, regulatory, infrastructural, and informational) for reducing behavioural and environmental risk were identified (appendix), and 29 of these were identified as candidates for early implementation. In addition to intersectoral policies, DCP3 selectively reviews policies that affect the uptake of health sector interventions (eg, conditional cash transfers) and the quality with which they are delivered.²⁸

The DCP3 approach

We have thoroughly updated findings from DCP2 on costs, effectiveness, and cost-effectiveness. The literature

See Online for appendix

Panel 4: Evidence for policy: from research findings to policy parameters

Analysis in *Disease Control Priorities*, 3rd edition (DCP3) proceeds by attempting to make the best use of the evidence available for informing important decisions rather than exclusively using what ideally generated evidence has to say.³⁰ The distinction is important. An example is illustrative: quite good evidence is available on the effect of vector control on malaria mortality in specific environments; likewise there is strong evidence concerning treatment efficacy, but very little evidence exists on whether vector control and treatment are substitutes, complements, or additive in reducing mortality, yet this is the important question for policy.

Inevitably imperfectly, our task in the *Disease Control Priorities* series, beginning with the 1st edition, has been to combine the (sometimes) good science about unidimensional intervention in very specific locales with informed judgment to reach reasonable conclusions about the effect of intervention mixes in diverse environments. To put this slightly differently, the parameters required for assessing policy differ, often substantially, from what has been addressed (so far) in the scientific literature. The transition from research findings to policy parameters requires judgment to complement the research and, often, a consideration of underlying mechanisms (eg, use of incentives) that might suggest generalisability.³¹

In particular, four types of judgments were often needed in the course of DCP3 to make the transition from research findings to evidence for policy.

1 Similar interventions

Assume we have evidence that intervention A is effective, and we believe intervention B is quite similar (eg, two lipid-lowering drugs). We use judgment to infer that intervention B is (or perhaps is not) also effective.

2 Combined interventions

As in the malaria example above, assume that evidence shows interventions A and B are both effective. What about the combination of interventions A and B? Hard evidence on combinations is far more rare than evidence on individual interventions.

3 Changed settings

We have strong evidence that antimalarial bednets reduce all-cause child mortality when mosquitoes bite indoors at night, at moderate intensity. Although the available evidence concludes that bednets were effective where evaluated, other biological considerations suggest that evidence be rejected in an environment with very high biting intensity. Economists have discussed this point in the context of external validity. Ozler provides a clear overview.³²

4 Trait-treatment interactions

Finally, patient characteristics might differ. Measles immunisation in healthy child populations might have been shown to have no effect on mortality. Generalising that finding to a population with different traits (eg, undernourished or sickly children) might (and in this case would) generate an unfortunate false negative.

Evidence can be weak. Or, as in the examples above, evidence can be strong but only partially relevant. Weak evidence for effectiveness, or partially relevant evidence for effectiveness, is often likewise weak evidence for lack of effectiveness. Interpreting weak evidence as grounds for rejecting an intervention could generate false negatives that cost lives. The attempt in DCP3 has been to unashamedly combine evidence with informed judgment to judiciously balance false positives and false negatives.

provides much of specific interest, but formulation of policy, when informed by evidence at all, requires expert judgment to fill extensive gaps in the economic evaluation literature. The question to be addressed is one of how to construct a cost-constrained benefit package for UHC. Recent analyses have provided

thoughtful discussion of considerations involved, including human rights.^{24,29} The DCP3 approach draws heavily on this prior work but with more emphasis on non-health outcomes of health systems. In this section we discuss the DCP3 approach that led both to a 3P approach (packages, policies, and platforms) and to the specific content for intersectoral policy and for the packages and platforms. The methods are described more fully in the tables.

Using research (or other) evidence to guide policy is most simply done when randomised controlled trials of the relevant intervention (mix) have been undertaken on the population of interest in the appropriate ecological setting. Even in high-income countries such strong evidence is rarely available. In lower-income environments the evidence quality problem is compounded. As always, evidence must be used to help decision makers avoid adopting interventions that do not work in a given context and avoid rejecting those that do (panel 4).

The methods and findings of DCP3's approaches to economic evaluation appear in three separate chapters of DCP3's concluding volume: one chapter on cost-effectiveness analysis,³³ one on benefit-cost analysis,³⁴ and one on extended cost-effectiveness analysis.³⁵ A high-level overview of DCP3's economic methods and findings appears in the appendix. In populations without access to health insurance or prepaid care, medical expenses that are high relative to income can be impoverishing. In most of the literature on medical impoverishment, the medical conditions responsible for this impoverishment are not identified. Essue and colleagues³⁶ point to where specific causes of medical impoverishment are known, which is obviously a central point for construction of benefits packages.

Although multiple studies document the overall magnitude of medical impoverishment, most economic assessments of health interventions and their finance have not adequately addressed the important question of efficiency in the purchase of financial protection. In work undertaken for DCP3, extended cost-effectiveness analysis was developed to explicitly include financial protection (and equity) in economic assessment of health interventions.³⁷

Editors of DCP3's first eight volumes and authors of specific chapters in volume 9 (on rehabilitation,³⁸ on pathology,³⁹ on palliative care,⁴⁰ and pandemic preparedness⁴¹) constructed the 21 essential packages listed in panel 3. The authors of this Review then consolidated those policies and formats into a common level of aggregation and a common structure (eg, screening was not considered an intervention by itself but only in conjunction with the indicated response). This generated a set of harmonised essential packages (the originals appear as appendices to the first chapter of DCP3; the second and third chapter provide a full discussion of methods⁴²⁻⁴⁴). Several interventions appear in more than one package, but the final lists of 71 intersectoral

policies and 218 EUHC interventions remove this duplication. A consequence is that the cost of EUHC is less than the sum of the costs of the packages within it.

Intersectoral policies for health

15 of DCP3's 21 essential packages contained a total of 71 intersectoral policies. These policies fall into four broad categories: (1) taxes and subsidies (15 of 71 intersectoral policies); regulations and related enforcement mechanisms (38 of 71 intersectoral policies); built environment (11 of 71 intersectoral policies); and informational (seven of 71 intersectoral policies). A complete listing of the 71 intersectoral policies is available in the appendix. These policies are designed to reduce the population level of behavioural and environmental risk factors (tobacco and alcohol use, air pollution, micronutrient deficiencies in the diet, unsafe sexual behaviour, excessive sugar consumption, and others; figure 1). Watkins and colleagues⁴⁴ provide a thorough overview of DCP3's findings on intersectoral policy. Here we exemplify our approach with several of DCP3's findings

First, at initially low levels of income, the levels of many risk factors rise with income, thereby creating headwinds against which the health sector policy must proceed⁴⁵ but are at least potentially countered by sound policy. We identified 29 out of 71 intersectoral policies to be well worth considering for early adoption.

Second, for important categories of risk, such as pollution and transport risks, multiple sources for the risk exist, each of which is addressed through different modalities. Rather than a clear set of first priorities, there are multiple country or site-specific actions to be taken. Perhaps the single most important point to note is that the success of many high-income countries in reducing these risks to very low levels points to the great potential that these multiple policies can have for dealing, in particular, with air pollution and road traffic injuries.

Third, potentially important areas of dietary risk remain unaddressed by the policies identified in DCP3. These areas concern the macronutrients—carbohydrates, fats, and proteins. The most recent assessment of risk factors for the Global Burden of Disease (GBD) points to the reason for limited policy guidance.⁴⁶ The GBD lists 11 risk factors in the category of child and maternal malnutrition, but only two of these risk factors are dietary (both concern breastfeeding). The other risk factors, such as child wasting, are what we label physiological (figure 1) and are consequences of diet and disease history. GBD lists 15 risk factors for non-communicable disease, all of them dietary (eg, diets low in fruits). These dietary risk factors do provide directions for intersectoral policy,⁴⁷ and relevant policies are included in the DCP3 list of 71 intersectoral policies. Yet empirical studies to guide major macronutrient policy directions, for example toward reducing intake of carbohydrates or fats, are only beginning to appear.^{48,49} Much policy interest (eg, taxes) would rely on this missing information.

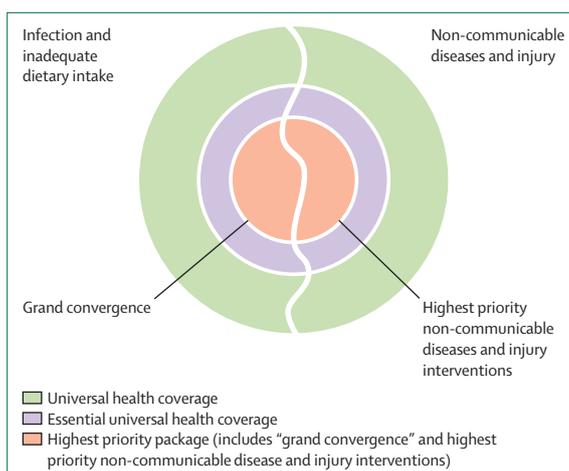


Figure 2: Essential universal health coverage and the highest priority package
The grand convergence agenda for reducing child and infectious disease mortality was advanced by the *Lancet* Commission on Investing in Health.²¹

A fourth point is that existing analyses of genetic risk and of medical intervention risk remain to be included in disease burden studies.⁴⁶ Although genetics cannot be ethically changed, genetic information can be an important guide to intervention. Medical risks can be quite substantial as Atul Gawande and Tom Weiser⁵⁰ document in the DCP3 chapter on quality of surgical care. Some medical risks are side-effects of inherent risks from intervention, some are medical error, and some result from inadequate resources available to the provider. We discuss genetic risk and intervention risk along with other risk factors although, clearly, the health system itself provides the compensatory interventions.

A fifth point is that fiscal policies (finance ministry policies) are important. Discussion of these policies has most prominently involved large increases in excise taxation of tobacco, with emerging evidence on taxation of alcohol and sugar-sweetened beverages. But the possibilities for taxation extend to sugar production and imports, fossil fuels (or carbon), and industrial or vehicle emissions. Also of importance is reducing expensive subsidies that now exist on fossil fuels and, often, on unhealthy food production or unhealthy child dietary supplements. Although health improvement might be only one of several objectives for lowering subsidies, it is an important one. The scientific literature on the health potential for removing subsidies is limited. But the sheer magnitude of some of these subsidies, as the International Monetary Fund has stressed, points to the value of careful further analysis. In all likelihood, the finance ministry is the most important ministry (after health) for improving population health. And many (not all) of the measures a finance ministry can take would enhance public sector revenue.

Essential universal health coverage

At the heart of DCP3 was a review of available evidence on health-sector interventions' costs, effectiveness,

| | Low-income countries | | | | Lower-middle-income countries | | | |
|---------------------------------|--|------------------------------------|--|---|---|------------------------------------|--|---|
| | Projected number of premature deaths, 2030 (millions)* | 40×30 reduction target (millions)† | Expected reduction in premature deaths from HPP (millions) | Expected reduction in premature deaths from EUHC (millions) | Projected number of premature deaths, 2030 (millions) | 40×30 reduction target (millions)† | Expected reduction in premature deaths from HPP (millions) | Expected reduction in premature deaths from EUHC (millions) |
| Age (years) | | | | | | | | |
| 0–4 | 2.2 | 1.5 | 0.62 | 0.77 | 3.3 | 2.2 | 1.1 | 1.3 |
| 5–69 | 5.2 | 1.5 | 0.99 | 1.2 | 14 | 4.8 | 2.2 | 2.9 |
| 0–69 | 7.4 | 3.0 | 1.6 | 2.0 | 17 | 7.0 | 3.2 | 4.2 |
| By cause (age ≥5 years)‡ | | | | | | | | |
| Group 1 | 1.9 | 0.76 | 0.59 | 0.65 | 3.2 | 1.5 | 0.85 | 0.94 |
| Tuberculosis | 0.34 | 0.22 | 0.11 | 0.13 | 0.90 | 0.60 | 0.29 | 0.35 |
| HIV/AIDS | 0.44 | 0.29 | 0.18 | 0.20 | 0.48 | 0.32 | 0.23 | 0.26 |
| Malaria | 0.087 | 0.058 | 0.051 | 0.051 | 0.055 | 0.037 | 0.026 | 0.026 |
| Maternal conditions | 0.17 | 0.11 | 0.075 | 0.086 | 0.20 | 0.13 | 0.079 | 0.092 |
| Other diseases | 0.90 | 0.074 | 0.18 | 0.18 | 1.6 | 0.40 | 0.22 | 0.22 |
| Group 2 | 2.5 | 0.60 | 0.36 | 0.53 | 8.9 | 2.7 | 1.3 | 1.9 |
| Neoplasms | 0.65 | 0.22 | 0.010 | 0.039 | 1.8 | 0.60 | 0.10 | 0.16 |
| Cardiovascular diseases | 0.93 | 0.31 | 0.24 | 0.36 | 4.0 | 1.3 | 0.89 | 1.4 |
| Other diseases | 0.93 | 0.076 | 0.11 | 0.13 | 3.2 | 0.80 | 0.28 | 0.35 |
| Group 3 | 0.77 | 0.13 | 0.043 | 0.060 | 2.0 | 0.54 | 0.070 | 0.10 |
| Road injuries | 0.25 | 0.085 | 0.032 | 0.046 | 0.57 | 0.19 | 0.048 | 0.069 |
| Other injuries | 0.52 | 0.042 | 0.010 | 0.014 | 1.4 | 0.36 | 0.022 | 0.032 |

The cost and diseases structures differ between and within income levels. We illustrate this by considering two income strata, but the analyses reported here can serve only as a starting point for national and subnational analyses. A premature death is death before age 70 years. We used the World Bank's income classification of low-income and lower-middle-income countries.⁵⁵ As a country's income changes, its classification can also change; for example, both Bangladesh and Kenya moved from low-income status to lower-middle income status after 2014. HPP=highest priority package. EUHC=essential universal health coverage. *The UN Population Prospects median population projection for 2030⁵⁶ was used to provide the population totals for calculating deaths by age and sex. †A reduction target of 40×30 is defined as a 40% reduction in premature deaths by 2030, relative to the number that would have occurred had 2015 mortality persisted to 2030. The target specifies a 40% reduction in deaths in people aged 0–69 years overall, a two-thirds reduction in under-5 deaths and adult deaths from tuberculosis, HIV/AIDS, malaria, and maternal conditions, and a one-third reduction in deaths from major non-communicable diseases. The quantitative targets above reflect these goals; however, targets for the residual categories (Other diseases and Other injuries) have been calculated in light of the targets for specific causes of death so that the total number of target deaths in people aged 5–69 years is sufficient to meet the 40×30 target. ‡WHO's Global Health Estimates provided the 2015 cause distributions of deaths for these calculations.⁵⁴ Sources: Watkins et al (2017)⁵⁷ and Watkins et al (in press).⁴⁸

Table 1: Implementation of essential packages: estimated reduction in premature deaths in 2030

implementability, and capacity to deliver significant outcomes. DCP3's nine volumes provide granular overviews of this evidence, and these overviews are directed to the implementation community and the policy community. Chapter 3 of volume 9 provides an integrative overview.⁴³ Each of the interventions on DCP3's five platforms are described in the appendix.

A schema of how DCP3 defines EUHC is shown in figure 2. Beyond EUHC is the full range of available, efficacious health-sector interventions or UHC. We estimate the financial requirements of EUHC and the HPP, but would also stress that WHO's notion of UHC emphasises quality of delivery. DCP3 dwells in some length on quality in surgery and in health care more generally.^{28,50} Although no country publicly finances all interventions, many high-income countries come close. Countries lie on a natural continuum of progress toward UHC. Short of EUHC is what DCP3 labels the HPP (the interventions included in the HPP are shown in the

appendix). Individual countries' highest priorities will differ from our model list for multiple reasons. That said, the HPP is intended to provide a useful starting point for national or subnational assessments. As with EUHC, DCP3's models provide estimates for the cost and impact of HPP. In *Global Health 2035*,²¹ the *Lancet* Commission on Investing in Health pointed to the possibility of a grand convergence, across most countries and in our lifetime, in under-5 mortality and mortality from major infections. Grand convergence within the DCP3 structure is illustrated in figure 2. In the two following subsections, we provide the DCP3 models' estimates of the mortality-reducing consequences and costs of EUHC. Achieving these gains will require substantial investments in health systems. Although the DCP3's costing model includes the cost of such investment, it was beyond the remit of DCP3 to address how to strengthen health systems. Mills and colleagues⁵¹ provide a valuable overview of the issues in the context of DCP.

Importantly, EUHC has a platform dealing with population-wide intervention, including intervention directed toward improving doctor practices with antibiotic use or inappropriate polypharmacy. In many cases, whether we denote an intervention to be intersectoral or to be population-wide prevention within the health sector is somewhat arbitrary.

Mortality reduction from essential UHC

Norheim and colleagues⁵² developed a structure, 40×30, for thinking about mortality reduction objectives in the Sustainable Development Goal 3 (SDG-3). Their starting point was the UN's Population Division (UNDP) projected age distribution of population in 2030, a distribution of deaths by age and cause generated from that age distribution of population, and mortality from 2010. The overall 40×30 goal was to reduce the calculated number of premature deaths by 40%, where premature death is defined as death before age 70 years. Subgoals were to reduce under-5 mortality and death from major infectious diseases by two-thirds and deaths from non-communicable disease and injury by a third. The DCP3 mortality impact model⁵³ follows the approach taken by Norheim and colleagues in broad terms but uses updated parameters. National applications of the DCP3 model will result in country-specific calculation and modification of these goals. The model's calculations start with a baseline age distribution of deaths by age and (broad) cause generated from the UNPD's projected age distribution of population and age in 2030 combined with cause-specific mortality from 2015.⁵⁴ It then estimates the effect of EUHC (and HPP) on mortality by assuming that the underlying intervention packages are implemented in the 15 years from 2015 to 2030 (the packages were designed to make this assumption reasonable). The age-specific and cause-specific mortality from counterfactual 2015 are then applied to the UNPD 2030 age distributions to give the age distributions of death by cause estimated to result from implementation of EUHC.

The DCP3 model enables comparison of the EUHC mortality profile to an explicit counterfactual baseline (table 1). Implementation of the HPP in low-income countries could achieve about half of the 40×30 goal (the estimated reduction in deaths is 1·6 million of the 40×30 target of 3·0 million). Full implementation of EUHC in lower-middle-income countries could achieve a little more than half of the 40×30 target of 2·2 million deaths averted in children younger than 5 years. The results for age group 5–69 years fall short of the 40×30 target of 4·8 million. Estimated deaths averted by EUHC (4·2 million) is about three-fifths of the 40×30 target of 7·0 million.

If we were to assume that both tools and implementation capacity improve between now and 2030 (the *Lancet* Commission on Investing in Health²¹ made an assumption of a 2% rate of technical progress

| | Low-income countries | | Lower-middle-income countries | |
|--|----------------------|--------------|-------------------------------|---------------|
| | HPP | EUHC | HPP | EUHC |
| Incremental annual cost*† | \$23 billion | \$48 billion | \$82 billion | \$160 billion |
| Incremental annual cost per person* | \$26 | \$53 | \$31 | \$61 |
| Total annual cost | \$38 billion | \$68 billion | \$160 billion | \$280 billion |
| Total annual cost per person† | \$42 | \$76 | \$58 | \$110 |
| Incremental annual cost as a percentage of current GNI per person* | 3·1% | 6·4% | 1·5% | 2·9% |
| Total annual cost (as percentage of GNI per person)‡ | 5·1% | 9·1% | 2·8% | 5·2% |

The cost and disease structures differ between and within income levels. We illustrate that by considering two income strata, but the analyses reported here can serve only as a starting point for national and subnational analyses. Lower and upper uncertainty ranges were derived from optimistic and pessimistic cost scenarios (respectively) that were based on variations in key parameters in the costing model. Uncertainty ranges are provided in the appendix. We use the World Bank's 2014 income classification of low-income and lower-middle-income countries.⁵⁵ As a country's income changes its classification can also change; for example, both Bangladesh and Kenya moved from low-income to lower-middle income after 2014. GNI=gross national income. *The 2015 population of low-income countries was 0·90 billion people, whereas the 2015 population for lower-middle-income countries was 2·7 billion people. †Incremental annual cost is the estimated cost of going from current to full (80%) coverage of the EUHC and HPP interventions. The total annual cost is the incremental cost plus the estimated cost of the current level of coverage assuming the same cost structure for current as for incremental coverage. Estimated costs are inclusive of estimates for (large) health-system strengthening costs and are steady state (or long-term average) costs in that investments to achieve higher levels of coverage and to cover depreciation are included. ‡The 2015 GNI per capita of low-income countries was US\$830. For lower-middle-income countries it was \$2100. Note that GNI data were only available for countries covering 84% and 96% of the population of low-income and lower-middle-income countries, respectively. Data were less likely to be available for poorer countries and fragile states, hence these GNI figures are likely to be an overestimate of income, particularly in the low-income country group. Source: Watkins et al (2017).⁵⁷

Table 2: Total and incremental annual costs of essential universal health coverage (EUHC) and the highest priority package (HPP), 2015 (in US\$[2012])

| | Low-income countries | | Lower-middle-income countries | |
|--|----------------------|------|-------------------------------|------|
| | HPP | EUHC | HPP | EUHC |
| Incremental costs by platform (percentage of total) | | | | |
| Population-based | 0·6% | 2·3% | 0·6% | 2·0% |
| Community | 18% | 16% | 12% | 14% |
| Health centre | 50% | 52% | 57% | 52% |
| First-level hospital | 25% | 25% | 22% | 25% |
| Referral and specialty hospitals | 6·4% | 5·2% | 9·1% | 6·1% |
| Incremental costs by intervention urgency (percentage of total) | | | | |
| Urgent | 35% | 28% | 27% | 24% |
| Chronic | 41% | 48% | 50% | 52% |
| Time-bound (non-urgent) | 24% | 24% | 23% | 24% |

The cost and disease structures differ between and within income levels. This is illustrated by considering two income strata, but the analyses reported here can serve only as a starting point for national and subnational analyses. Sources: Watkins et al (2017)⁵⁷ and Watkins et al (in press).⁴³

Table 3: Incremental costs of the highest priority package (HPP) and the essential universal health coverage (EUHC) by platform and by intervention urgency

in one of their scenarios), then the reduction in deaths from EUHC could be more substantial than shown in table 1. Likewise, the reduction in behavioural and environmental risk could be greater than anticipated. Such progress is certainly possible but might be

| | Lancet Commission on Investing in Health ²¹ | DCP3 ^{50,54} | WHO 2017 ¹¹ |
|---|---|---|---|
| Countries included | 34 low-income and three (large) lower-middle-income countries* | 34 low-income and 49 lower-middle-income countries* | 67 low-income, lower-middle, and upper-middle-income countries individually estimated and then aggregated† |
| Key definitions and intervention range covered | Grand convergence interventions lead to very substantial cross-country convergence in under-5, maternal, tuberculosis, malaria, and HIV/AIDS mortality and in the prevalence of neglected tropical diseases | 21 packages (table 1) identified in terms that include intersectoral and health sector interventions (72 distinct intersectoral interventions and 244 distinct health sector interventions); EUHC are health sector interventions in the 21 packages (covered in national health accounts and potentially included in benefits packages); a highest priority subset of EUHC (HPP) includes a limited range of interventions against non-communicable diseases, injuries, and cross-cutting areas such as rehabilitation and palliative care, in addition to the grand convergence interventions | Investments were modelled for 16 SDGs, including 187 health interventions and a range of health-system strengthening strategies (the latter of which included investments required to achieve target levels of health workforce, facilities, and other health-system building blocks); two scenarios were modelled, a progress scenario (in which coverage is limited by the absorptive capacity of current systems to incorporate new interventions), and an ambitious scenario (in which most countries achieve high levels of intervention coverage and hence SDG targets) |
| Intersectoral action for health | Extensive discussion of intersectoral actions for health but not included in modelling grand convergence | Intersectoral interventions defined as those typically managed and financed outside the health sector; each of the 21 packages contains the intersectoral interventions deemed relevant; the costs and effects of intersectoral action on mortality reduction are not explicitly modelled | WHO 2017 scenarios include some finance of intersectoral interventions from the health-sector perspective, as well as their effects on mortality |
| Intervention coverage | Full coverage defined at 85%; rates of scale-up defined using historical data on so-called best performers among similar groups of countries | Full coverage defined as 80%; the HPP differs from EUHC not in coverage level but in the scope of interventions included | Full coverage defined as 95% for most interventions in the ambitious scenario, with a range from 53% to 99% depending on intervention |
| Estimated additional costs (including requisite investment in health system capacity) | | | |
| Low-income countries | US\$(2011)30 billion annually between 2016 and 2030 | HPP: US\$(2012)32 billion in 2030; EUHC: US\$(2012)70 billion in 2030 | US\$(2012)64 billion in 2030 |
| Lower-middle-income countries | US\$(2011)61 billion annually between 2016 and 2030 | HPP: US\$(2012)97 billion in 2030; EUHC: US\$(2012)190 billion in 2030 | US\$(2012)185 billion in 2030 |
| Estimated deaths averted‡§¶ | | | |
| Low-income countries | 4.5 million deaths averted per year between 2016 and 2030 | 2.0 million deaths averted in 2030 | 2.9 million deaths averted in 2030 |
| Lower middle-income countries | 5.8 million deaths averted per year between 2016 and 2030 | 4.2 million deaths averted in 2030 | 6.1 million deaths averted in 2030 |
| Benefit cost analysis undertaken | Yes | No | No |

EUHC=essential universal health coverage. HPP=highest priority package. SDGs=Sustainable Development Goals. *Separate estimates for the low-income and lower-middle-income country groups are provided. †Reported results are for all included countries combined. ‡DCP3 reports the number of premature deaths averted (ie, deaths younger than 70 years). §Averted deaths included stillbirths averted in the reports by the Lancet Commission on Investing in Health²¹ and WHO¹¹ but not in DCP3.^{53,57} ¶In the Lancet Commission report²¹ and DCP3, the reported deaths averted included only deaths averted in children actually born and women actually giving birth. Family planning averts unwanted pregnancies and hence potential deaths of women and children that would have occurred as a result of those averted pregnancies. The difference is large. For low-income countries, results of a sensitivity analysis in Global Health 2035⁵¹ showed that the more comprehensive estimate was 7.5 million deaths averted rather than the 4.5 million deaths averted shown in this table. WHO's 2017 estimates¹¹ of deaths averted are based on the larger and more inclusive number. Ambitious scale-up of family planning services accounted for 50% of averted child and maternal deaths and more than 65% of averted stillbirths in the WHO analysis (Stenberg K, Department of Health Systems Governance and Financing, WHO, personal communication). Sources: Jamison et al (2013),²¹ Boyle et al (2015),⁵⁸ Watkins et al (2017),⁵⁷ Watkins et al (2017),⁵³ and Stenberg et al (2017).⁵¹

Table 4: Costs and consequences of large-scale investment in health systems by the Lancet Commission on Investing in Health, Disease Control Priorities, 3rd edition (DCP3), and WHO

unlikely. The DCP3 model estimates what is technically and economically feasible given tools that are available at present. The results are indeed substantial—and are viable options for decision makers. But substantial resources are required, and the goals are incompletely met. The actual decision to commit resources remains, of course, in the hands of national authorities.

Costs

The DCP3 costing model provides two estimates of costs for the health-system component of each of DCP3's 21 essential packages.⁵⁷ The first was an estimate of how much additional funding it would take (in the 2015 cost and demographic environment) to implement each package to the extent judged feasible. The packages were designed so that for most cases full

implementation (ie, 80% effective coverage) was judged feasible by 2030. The second estimate was of total cost for the package defined as incremental cost plus an estimate of the amount already (in 2015) being spent on the intervention. The model estimates these costs both for low-income countries and for lower-middle-income countries. Some interventions were included in several packages, which was a natural outcome of a package formulation process that delineated packages as areas of concern to specific professional communities, such as surgeons or reproductive health specialists. Eliminating this duplication resulted in 218 distinct EUHC interventions. This implies that the sum of the package costs will exceed the cost of providing all packages. The subset of UHC that was judged (by explicit criteria) to be highest priority (ie, HPP) was costed in the same way

as for EUHC. Costs should be interpreted as long-term steady state costs—costs that include training of staff to replace retirements and investment to counter depreciation of equipment and facilities. Naturally, country-specific applications will be built on country-specific intervention lists and cost structures. The DCP3 costing model provides a tool to assist national health technology assessment units in developing national specifications, including analyses of a particular platform or package. Decision makers often wish to assess whether a particular intervention should be in or out, and Susan Horton³³ has summarised DCP3's intervention-specific cost-effectiveness analyses.

The expenditure increases required above as a percentage of gross national income (GNI) are shown in table 2). Additional detail is available in the appendix, and costs by package are available in chapter 3 of DCP3 volume 9.⁴² Just a small fraction of reasonably anticipated economic growth in most countries would cover the incremental costs of EUHC, although achieving the increased percentage of GNI required would require substantial reordering of public sector priorities.²¹ Additional (incremental) costs needed are substantial relative to current levels of public expenditure on health. In principle, projections could be made of changes in both the tradeable and non-tradeable components of cost, of the responsiveness of costs to demography (and in particular to fertility decline), and on whether improved transport and other infrastructure might reduce our estimates of the cost of expanding coverage to parts of the population that are ever more difficult to reach. This will be worthwhile in a country-specific context, but for purposes of reasonable overall cost estimates, we judged that adding these layers of assumption would add little or nothing to the information content of table 2.

Table 3 presents the DCP3 costing model's assessment of cost by platform and cost by degree of intervention urgency. More than half of our calculated costs occur at the health-centre level. For EUHC, another 15–25% each of incremental expenditures would go to the first-level hospital and to the community level. The health-systems implications for increasing intervention coverage plausibly differ markedly by urgency. Although DCP3 has taken a step forward with its systematic classification and costing, much work remains before implications for health systems are well understood. Continuing interventions require appropriate community capacity for delivery. Examples include antiretroviral therapy or antihypertensive therapy. Half of estimated incremental costs are needed to finance continuing intervention. Urgent interventions (eg, for trauma or obstructed labour) require that first-level hospitals be accessible quickly.²⁷ About a quarter to a third of incremental costs are required to provide this capacity. Time-bound but non-urgent interventions (eg, cataract extraction) allow patients to be accumulated over space and time with

concomitant potential for efficiency and quality resulting from high volume. The numbers of interventions on each platform according to degree of urgency are available in the appendix.

Reduction in mortality and the costs of major health-system investments were also modelled by the *Lancet* Commission on Investing in Health²¹ and WHO.¹¹ The estimates and differences between these analyses and those of DCP3 are summarised in table 4.

Conclusion

The nine volumes of DCP3 provide a granular assessment of technical and policy alternatives facing decision makers and opinion leaders in LMICs. DCP3 is particularly relevant as achievement of EUHC relies increasingly on greater domestic finance, with global developmental assistance in health focusing more on global public goods. In this Review, we have summarised the content of a model concept of EUHC and point to specific priorities for intersectoral action for health (panel 1).

Contributors

DTJ generated the basic plan for this study with inputs from AA, CNM, RN, and DGW. DTJ prepared the first draft with input and revisions from all authors. All authors approved the final draft before submission. DTJ had responsibility for submitting for publication.

Declaration of interests

DTJ, AA, CNM, RN, DGW, KD, and CL report grants from the Bill & Melinda Gates Foundation during the conduct of the study. KAF reports personal fees from the Centre for Global Health, National Cancer Institute during the conduct of the study. TG reports personal fees from Teva Pharmaceuticals and grants from United HealthCare Services and Novartis, outside the submitted work. FMK reports grants from Pfizer, Mayday Fund, American Cancer Society, Roche, CRDF Global, JM Foundation, Grunenthal, and GDS, during the conduct of the study; and grants, personal fees, and non-financial support from Roche, Pfizer, Novartis, GlaxoSmithKline, Merck/EMD Serono, Asociacion Mexicana de Industrias de Investigacion Farmaceutica, Sanofi, Chinoin, and NADRO, outside the submitted work. MEK reports personal fees from Merck for Mothers, outside the submitted work. DP reports grants from the University of Washington, during the conduct of the study. DAPB and DGW are employees of the Bill & Melinda Gates Foundation, and SB, CM, and JS have previously worked for the Bill & Melinda Gates Foundation, which funds the DCP3 series. DGW has managed the Disease Control Priorities Network grant since 2011. GH was previously affiliated with the Water and Sanitation Program, World Bank, Washington, DC, USA. DC, AC, TD, JM, and TR are staff members of the World Health Organization. The authors alone are responsible for the views expressed in this Review and they do not necessarily represent the decisions, policy, or views of the World Health Organization. All other authors declare no competing interests.

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